UNIVERSITY OF ALBERTA

THE AGRICULTURAL LANDSCAPE OF EASTERN EL SALVADOR

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

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by

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PREFACE

The purpose of this paper is to depict the agricultural landscape of eastern El Salvador (see Map I) in its entirety. To achieve this I employ a method which was first developed at the University of Zurich, Switzerland, and demonstrated in the field by Dr. Hans Caroll in the Karroo and at Stellenbosch, Republic of South Africa.[1]

To grasp the complexity of the agricultural landscape I approach the landscape from two vantage points: (1) its form, and (2) its function. In the context of this paper these are referred to as the "Formal" and the "Functional" approaches. The "Formal" approach, as the name indicates, is concerned with the physiography or the "form" of the landscape, while the "Functional" approach is concerned with the human influences, and the resulting effects on the landscape, and the changes of both through time.

In 1961, I had the opportunity to return to Central America and visit the Republic of El Salvador for five weeks. I chose to undertake the five-thousand mile trip from Edmonton to San Salvador by car, which enabled me to pass through parts of Mexico and Central America theretofore unfamiliar to me.

However, the underlying reason for the trip was to study the agricultural landscape of eastern El Salvador. The desire to write on this topic grew out of my great interest in Latin America inspired as

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[1] H. Caroll, "Das Agrargeographische Betrachtungssystem, ein Beitrag zur landschaftskundlichen Methodik, dargelegt am beispiel der Karru in Sudafrika", Geographica Helvetica, No. 1, Bern, 1952, pp. 17-67.

a young boy through my reading acquaintance of Alexander von Humboldt's travel books. After the Second World War, I spent the years from 1948 to 1951, in Central America, and it was then that I first became interested in agricultural problems of Latin America.

During my short five-week visit, I covered more than two thousand miles of road throughout eastern El Salvador and other parts of the Republic. I investigated numerous agricultural holdings from small one or two acre corn farms to large coffee and cotton estates. Part I of this thesis is based on material obtained from interlibrary loan through the courtesy of the University of Alberta Library, while Part II is largely the direct outcome of investigations in the field and material obtained from various government branches of the Republic of El Salvador.

I was cordially received and assisted with my investigations by government officials in San Salvador and San Miguel by numerous land owners and small farmers. I particularly wish to thank Dr. Miguel F. Charlaix, the Governor of the Department of San Miguel, who personally saw to it that I received the help and cooperation of all mayors and law enforcement officers throughout the department, Dr. Fritz Loenholdt of the F.A.O., who made considerable material pertinent to this paper available to me, Dr. Helmuth Lessmann, Head of the Department of Meteorology, Ing. Pablo Guzman, Head of the Department of Cartography, Don Carlos Prieto, the owner of Hacienda El Delirio, Don Federico Prieto, the owner of Finca El Carmen, and Sr. Roberto Harrison, a personal friend. I particularly wish to acknowledge the assistance of my advisor, Dr. John F. Bergmann, and my wife Deborah, who gave their time and advice to make this paper possible.

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INTRODUCTION

The Republic of El Salvador is that part of Central America which is located along the Pacific Coast, between north latitude 13°8' and 14°24' and longitudes 87°39' and 90°8' west (see Map I). Its area covers approximately 21,160 sq.kms.[1] (8,265 sq. mi.) and is approximately rectangular in shape. Bounded on the west by Guatemala, on the north and east by Honduras, the Republic faces only one ocean and shares the Gulf of Fonseca with Honduras and Nicaragua. The northern boundary with Honduras has as yet not been definitely demarcated.

Aside from being the smallest of the Latin American Republics, El Salvador is also, with the exception of Haiti, the most densely populated. Little El Salvador is a land of mountains and fertile upland plains. Its principal topographic features are a narrow coastal belt approximately 321 kms. long, a range of young volcanic mountains traversing the Republic from the border of Guatemala to the Gulf of Fonseca, a central plateau hemmed in between the range of young volcanic mountains and the western flank of the Central American Cordillera which forms the frontier with Honduras.

Located entirely within the tropics, El Salvador, due to its position on the west side of the continent, is not exposed to the moisture-laden Trade winds of the Atlantic and thus has a distinct wet and dry season. Temperature varies with altitude and is generally warm rather than hot. The Republic is predominantly agricultural. Coffee is the main export and the key to agricultural activity. The economy is comparatively self-sufficient but many commodities must be

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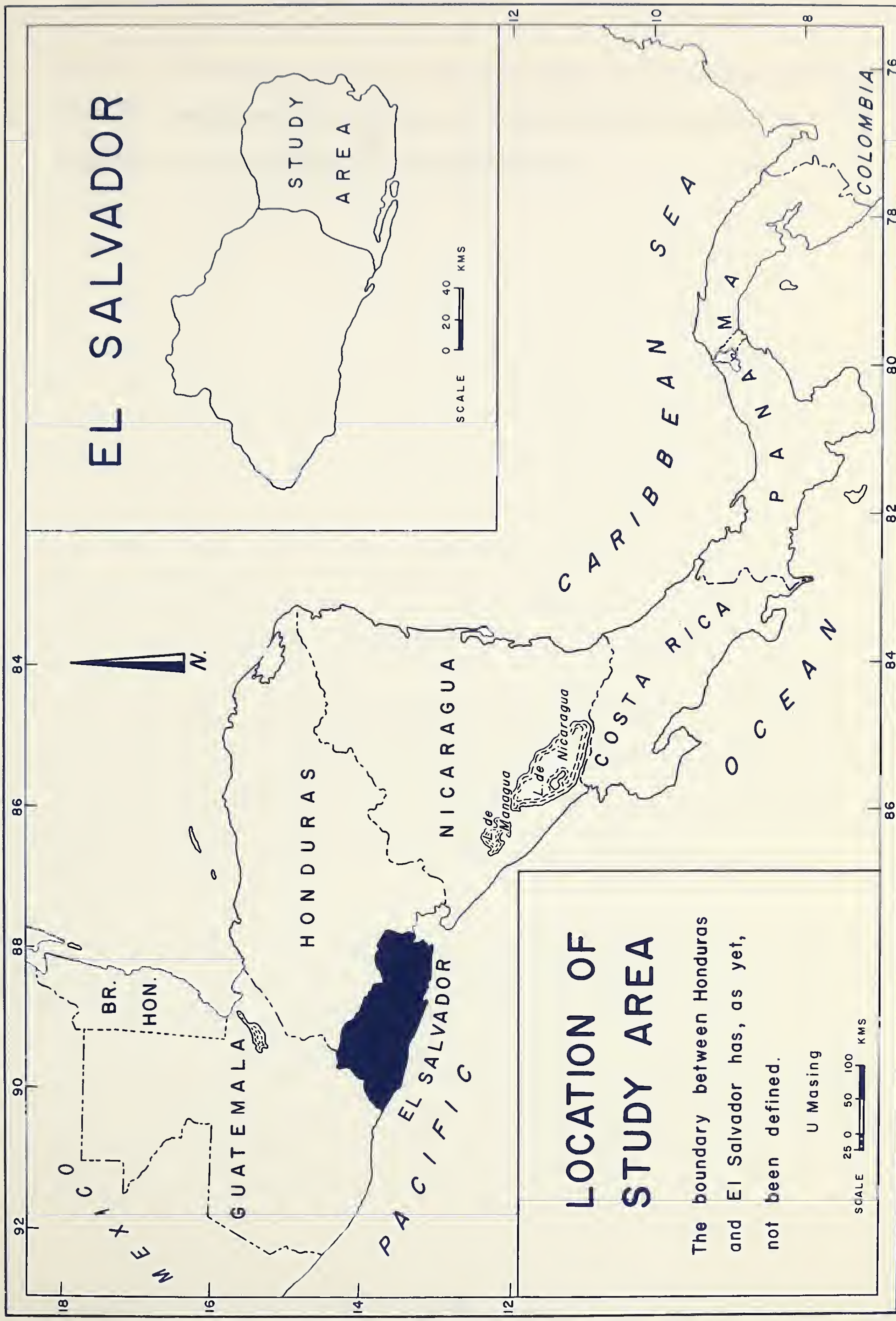
[1] See Appendix A.


LOCATION OF
STUDY AREA
The boundary between Honduras
and El Salvador has, as yet,
not been defined.
U Masing
SCALE 25 0 50 100 KMS
EL SALVADOR
STUDY AREA
SCALE 0 20 40 KMS
N.
MEXICO
BR. HON.
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
L. de Managua
L. de Nicaragua
COSTA RICA
PANAMA
COLOMBIA
CARIBBEAN SEA
PACIFIC OCEAN
92
90
88
86
84
82
80
78
76
18
16
14
12
10
8

MAP I

imported. Although it is one of the most highly industrialized countries in Central America it lacks a strong industrial base and is weakened by limited industrial diversification.

PART I

THE ELEMENTS OF THE AGRICULTURAL LANDSCAPE OF EL SALVADOR

In Part I the agricultural landscape of El Salvador is examined on the basis of its component elements, both formal and functional, through time, to provide a background with which the present agricultural landscape of eastern El Salvador can be compared.

CHAPTER I

PHYSICAL ELEMENTS OF THE LANDSCAPE

Geomorphology

Central America is generally defined as the land bridge between North America and South America taking in the Crown Colony British Honduras and the Republics of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama. For the purpose of this discussion however, we shall include México east of the Isthmus of Tehuantepec.

Geologically Central America is extremely complex and as yet, little known. At the present there exists no completely satisfactory and universally accepted explanation of its geological history. Essentially the region is occupied by two distinct orographic systems that were separated during Tertiary times by a wide sea which made any interchange of fauna and flora between the two systems impossible.[1] These two systems are: (1) the northern or nuclear region, situated between the Isthmus of Tehuantepec to the north and the Nicaragua Depression to the south, and (2) the younger isthmian link, between the Nicaragua Depression and the Atráto Depression of Colombia. Because El Salvador lies within the northern region we shall concern ourselves with that region only.

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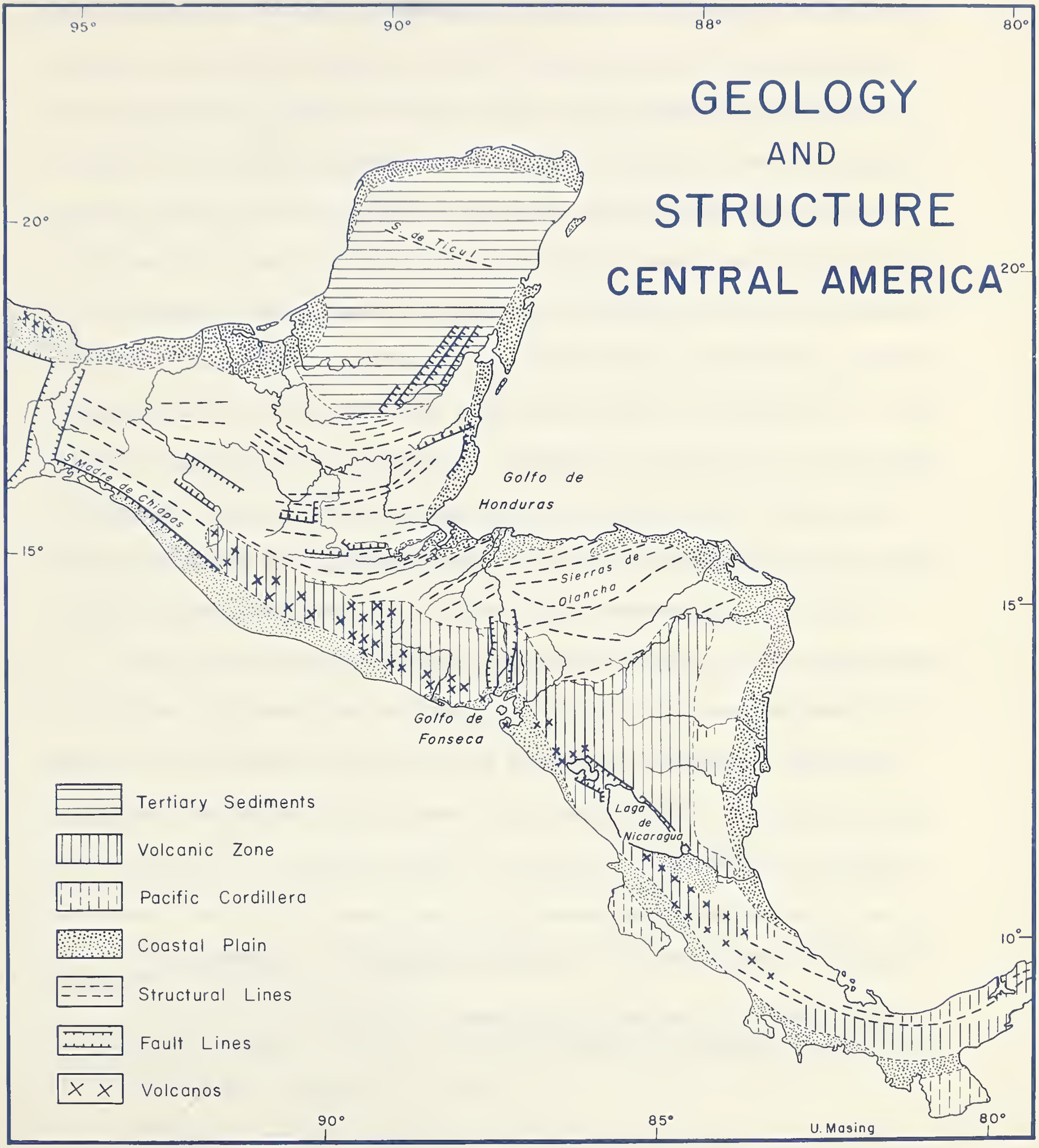
[1] O. Schmieder, Geografia de America, México, 1946, p. 677.



95°
90°
88°
80°
GEOLOGY
AND
STRUCTURE
CENTRAL AMERICA
20°
15°
10°
S. de Ticul
S. Madre de Chiapas
Golfo de
Honduras
Sierras de
Olancho
Golfo de
Fonseca
Laga
de
Nicaragua
Tertiary Sediments
Volcanic Zone
Pacific Cordillera
Coastal Plain
Structural Lines
Fault Lines
Volcanos
90°
85°
80°
U. Masing

MAP II

The mountains that traverse the center of the northern region in an east-west direction, stretching from Chiapas in Mexico through central Guatemala, northern Honduras, and northern Nicaragua, were formed at the close of the Permian, in the Cretaceous, and toward the end of the Miocene,[2] by crustal movement rather than volcanism, and are very complex in their physiography, development, structure, and petrology.[3] These mountains are generally referred to as the Antillean system to differentiate them from the Pacific Cordillera which was formed during the Pliocene. "As a result of thrusting from the Pacific, the southern portion of Guatemala was crowded together against and over the east-west trending Antillean system, thus making the Pacific Cordillera."[4] The Pacific Cordillera is oriented in a generally north-west to south-east direction. On its western slopes are to be found most of the major volcanoes which were intensely active during the Pleistocene times, and in many cases have continued active to the present (see Map II).

Resting on top of the older sedimentary rocks of the Sierra Madre de Chiapas, these volcanoes form a continuous belt from Guatemala in an east to south-east direction across the Gulf of Fonseca, through the Nicaragua Depression into Panama where they end with the isolated volcano Chiriquí.[5] Nestled along the slopes of the Pacific Cordillera,

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[2] C. Schuchert, Historical Geology of the Antillean-Caribbean Region, New York, 1935, p. 315.

[3] H-G. Gierloff-Emden, "Erhebungen und Beiträge zu den physicalisch-geographischen Grundlagen von El Salvador", Hamburg, 1958, p. 17.

[4] Schuchert, op. cit., p. 319.

[5] Gierloff-Emden, op. cit., p. 18.
"In Guatemala beginnt in der streichenden Fortsetzung der Sierra Madre de Chiapas und ihrem Grundgerüst und Sedimentalmantel aufsitzend die grosse mittelamerikanische Vulkanzone, die, meist unmittelbar über die gehobene und schräg gestellte pazifische Küstenzone aufragend, die

which forms its northern boundary, lies the tiny Republic of El Salvador.

Physiographically El Salvador may be divided into four large regions (see Map III, Figure 1): (1) the young volcanic mountain chain called the Cadena Costera which forms the backbone of the Republic, (2) the old volcanoes of the peripheral mountain chain of Honduras, (3) the Great Interior Valley of the Rio Lempa, separating the two mountain chains, and (4) a narrow coastal plain broken in its continuity by the Sierra del Bálsamo and the Sierra de Jucuarán.

El Salvador has often been called The Land of Volcanoes, and not without reason. Whether the traveller approaches by land, sea, or air, the coastal mountain chain with its beautifully symetrical cones dominates the landscape. The volcanoes of this mountain chain rise above a series of grabens known collectively as the Zapotitan-Ilopango-Olomega Graben,[6] which traverses the Republic from east to west,[7] marking the sunken crest of a long and gently sloping geanticline.[8] Paralleling the coast at a distance of approximately 30 kms. rise the volcanoes Santa Ana (2,381 ms.), Izalco (1,965 ms.), San Salvador (1,985 ms.), San

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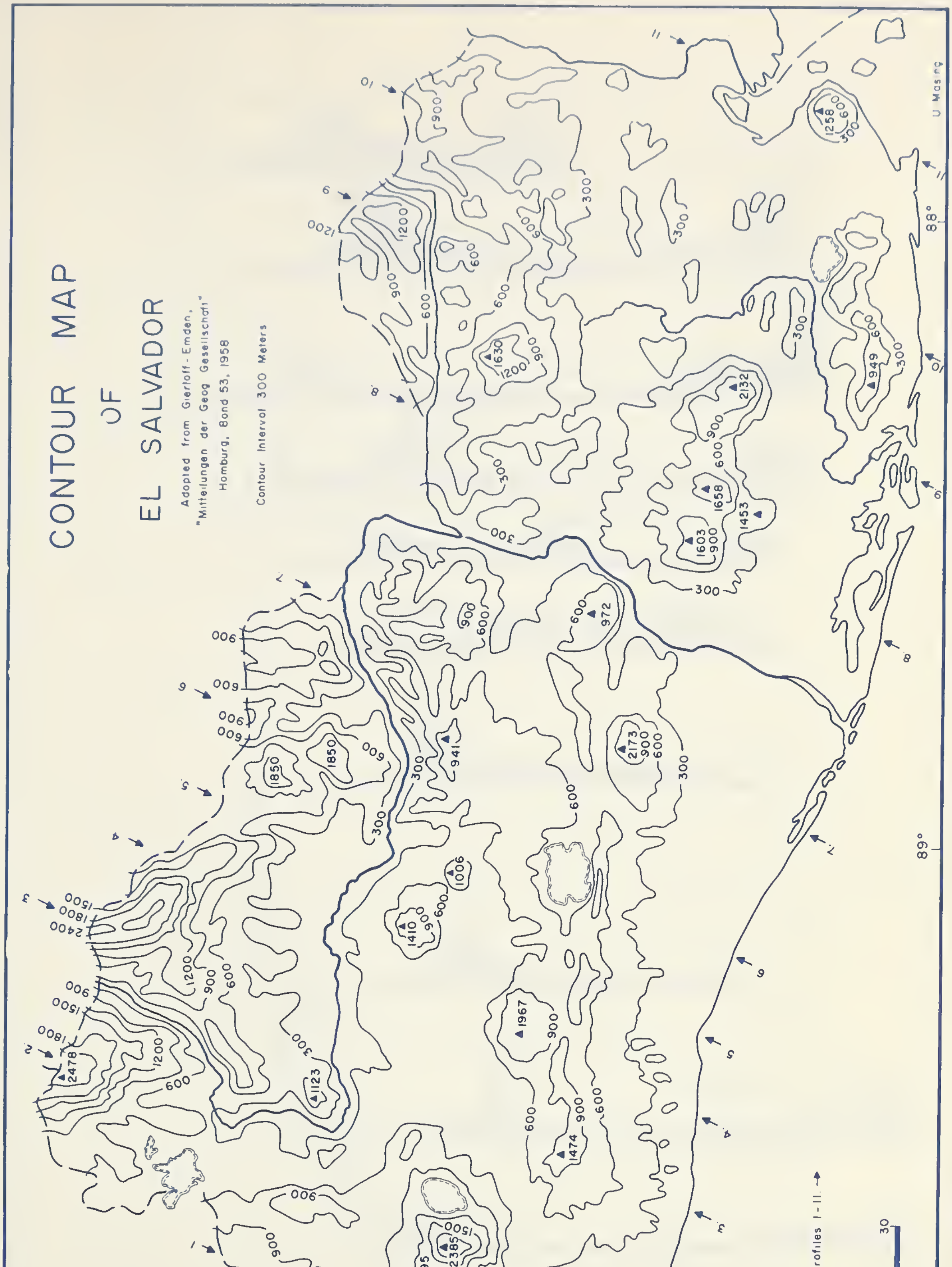
OSO - Richtung auch über den tief eingreifenden Einbruch der Fonseca-Bai beibehält, in die Grabensenke von Nicaragua eintritt und nahe der atlantischen Küste mit dem isolierten Vulkan Chiriqui endet."

[6] Gierloff-Emden, op. cit., p. 20.

[7] H.W. Grebe, "Los Lignitos del Area Ilobasco (Rio los Frailes) El Salvador (Centro America)", Comunicaciones del Instituto Tropical de Investigaciones Cientificas, Año III, No. 4, San Salvador, 1954, p. 124. All subsequent references to this source will use abbreviated form.

[8] H. Meyer-Abich and H. Williams, "Historia Volcanica del Lago de Coatepeque (El Salvador) y sus Alrededores", Comunicaciones del I.T.I.C., Año III, Nos. 2-3, San Salvador, 1954, p. 107.


CONTOUR MAP
OF
EL SALVADOR
Adopted from Gierloff-Emden,
"Mitteilungen der Geog Gesellschaft"
Hamburg, Band 53, 1958
Contour Interval 300 Meters
NOTE =
See Profile Map for Profiles I - II. →
SCALE
Kms
U Masing

MAP III

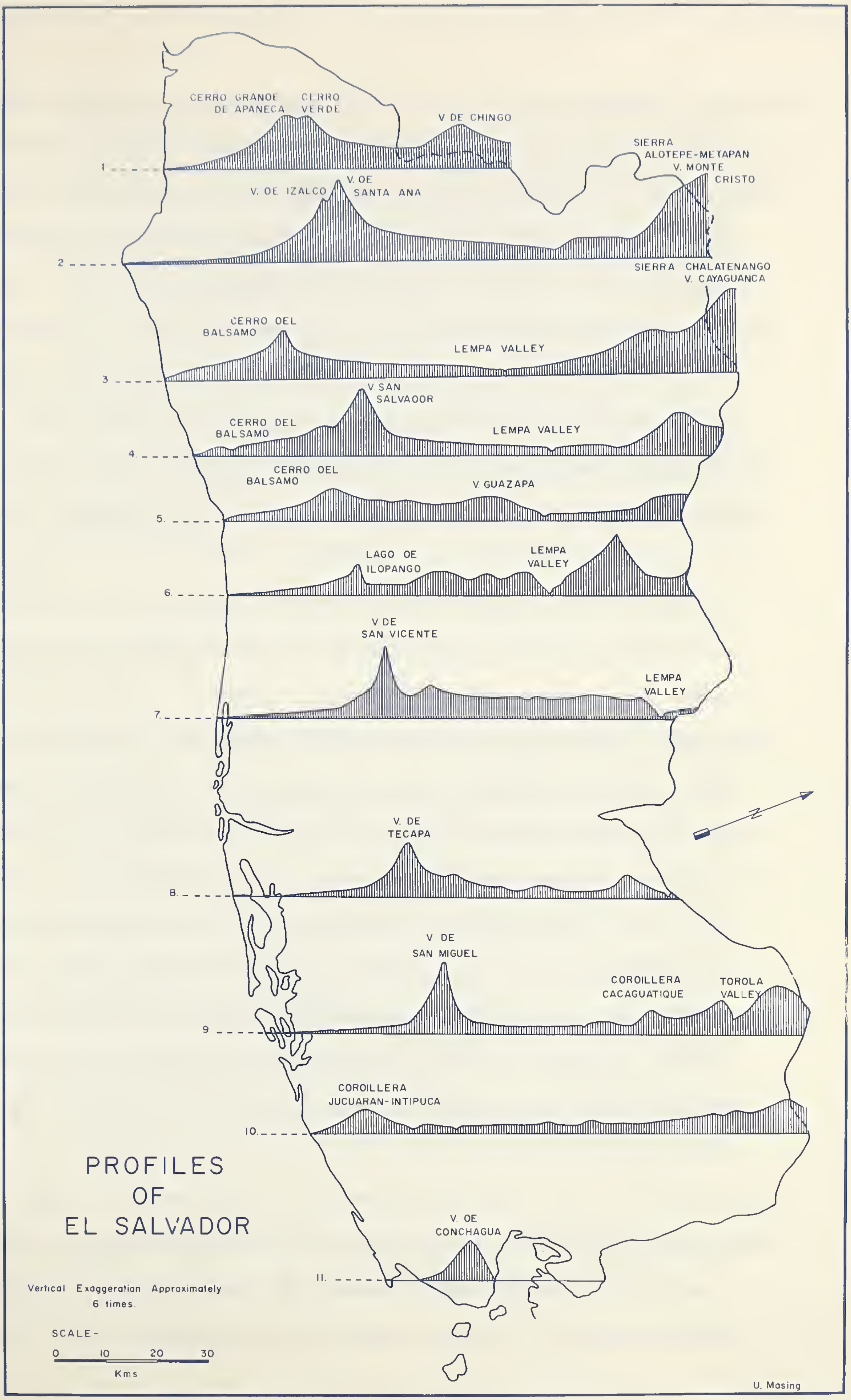

CERRO GRANOE DE APANECA
CERRO VERDE
V DE CHINGO
SIERRA ALOTEPE-METAPAN
V. MONTE CRISTO
V. OE IZALCO
V. OE SANTA ANA
SIERRA CHALATENANGO
V. CAYAGUANCA
CERRO OEL BALSAMO
LEMPA VALLEY
V. SAN SALVAOOR
CERRO DEL BALSAMO
LEMPA VALLEY
CERRO OEL BALSAMO
V. GUAZAPA
LAGO OE ILOPANGO
LEMPA VALLEY
V DE SAN VICENTE
LEMPA VALLEY
V. DE TECAPA
V DE SAN MIGUEL
COROILLERA CACAGUATIQUE
TOROLA VALLEY
COROILLERA JUCUARAN-INTIPUCA
V. OE CONCHAGUA
1
2
3
4
5
6
7
8
9
10
11
PROFILES OF EL SALVADOR
Vertical Exaggeration Approximately 6 times.
SCALE-
0 10 20 30
Kms
U. Masing

Fig. 1

Vicente (2,181 ms.), San Miguel (2,129 ms.), and the Conchágua (1,243 ms.) (see Figures 2-4). These volcanoes are not only the highest in the country but geologically are the youngest and best preserved. Without doubt, San Miguel is the most beautiful because of its near-perfect conical shape. Izalco, the youngest and at present the only active volcano of El Salvador, is often called The Lighthouse of Central America, for the glow of its eruptions can be seen by ships far out at sea.

The formation of these volcanoes began in late Pliocene and has continued to the present, filling most of the Zapotitán-Ilopango-Oloméga Graben, leaving the Basin of Zapotitán, Lake Ilopango, and Lake Oloméga as remnants of the original depression. To the south of the graben are two fault block mountains: the Sierra del Bálsamo and the Sierra de Jucuarán, both remnants of the southern slope of the old geanticline. Their escarpments, following a general east-west course, fall sharply into the graben to the north and slope gently to the south, disappearing beneath the Pacific. On reaching the coast they form a steep, rocky shoreline (see Figure 5), broken by scores of short, deeply-entrenched rivers. The escarpment of the Sierra del Bálsamo reaches heights of between 1,000 and 1,400 ms., and retreating from the coast, east of La Libertad, the mountains decline gradually. The Sierra del Bálsamo is composed largely of coarse conglomerates formed from volcanic mud (lodo), tuffbraccia, and sheet lavas, andesitic as well as basaltic, and is geologically older than the Pliocene volcanoes to the north (see Figure 6).

Little is known about the Sierra de Jucuarán. Like the Sierra del Bálsamo, it drops steeply to the north and has a very complex geological structure. Heavily eroded, the mountain spurs extend to the ocean, forming a 25 kilometer-long precipitous coast line, reaching heights

Fig. 2.--Volcan San Vicente with its twin peaks surrounded by fields of sugar cane, seen from the Pan American Highway.

Fig. 3.--Volcan San Miguel, the third highest and the most beautiful of El Salvador's volcanoes, seen from the Rio Grande de San Miguel Lowlands to the east.

Fig. 4.--Volcan Conchagua, the easternmost of El Salvador's volcanoes, rises out of the Gulf of Fonseca, seen from the new littoral highway west of the volcano.

Fig. 5.--West of La Libertad the Sierra del Balsamo slopes gently toward the coast where it forms a steep, rocky shoreline, broken by numerous short, deeply entrenched rivers.

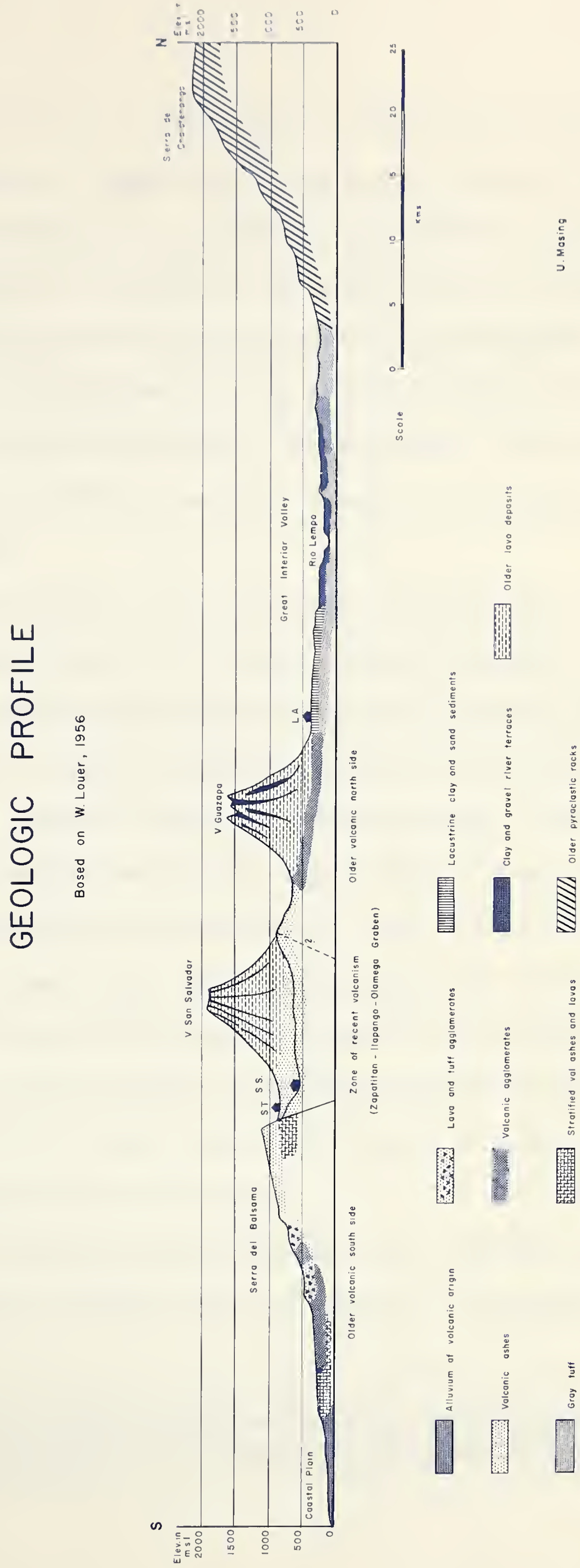

GEOLOGIC PROFILE
Based on W. Lauer, 1956
S
N
Elev. in m s l
2000
1500
1000
500
0
Coastal Plain
Serra del Balsamo
S T
S S.
V San Salvador
V Guazapa
L A
Great Interior Valley
Rio Lempa
Older volcanic south side
Zone of recent volcanism
(Zapotitan - Ilopango - Olomega Graben)
Older volcanic north side
Scale
0
5
10
15
20
25
Kms
U. Masing
Alluvium of volcanic origin
Lava and tuff agglomerates
Lacustrine clay and sand sediments
Volcanic ashes
Volcanic agglomerates
Clay and gravel river terraces
Older lava deposits
Gray tuff
Stratified vol ashes and lavas
Older pyroclastic rocks

Fig. 6

from 20 to 80 ms..[9]

East of the Rio de Paz a narrow belt of coastal plain enters El Salvador from Guatemala. Paralleling the coast for a distance of 5 to 10 kms., the plain widens north of Acajutla and is pinched off by the Sierra del Balsamo east of Acajutla at the mouth of the Rio Apancoyo. East of La Libertad the coastal plain continues for approximately 110 kms., again to be interrupted in its continuity by the Sierra de Jucuaran, reaching its greatest width at the Rio Lempa. Both plains are composed largely of volcanic materials (see Figure 7) rising gently towards the interior.

The peripheral mountain chain of Honduras, an extention of the Sierra Madre de Chiapas, forms the boundary between Guatemala, Honduras, and El Salvador, and following a generally east-west direction, penetrates El Salvador to a width of about 25 kms. north of the Rio Lempa and the Rio Torola. Little is known about these mountains. Where they enter El Salvador, north of the Lago de Güija, they are known as the Sierra de Metapan and continue across the Rio Lempa as the Sierra de Chalatenango. The highest point known is the extinct Volcan de Montecristo (2,440 ms.), which marks the meeting point of the borders between Guatemala, Honduras, and El Salvador. Also little known are the mountains north of the Rio Torola which reach heights of 1,300 ms., and form the steep northern flank of the river.

Between the two mountain chains lies the Great Interior Valley, interrupted by numerous isolated peaks and clusters of volcanoes, the

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[9] H-G. Gierloff-Emden, "Vier Karten zur Physischen Geographie von El Salvador", Erdkunde, Archiv für wissenschaftliche Geographie, Band 53, Lfg. 1, Bonn, 1957, p. 60.

highest of which are Chingo (1,777 ms.), Guazapa (1,420 ms.), and Cacaguatique (1,524 ms.). Their peaks rising 500 to 800 ms. above the valley floor dominate the landscape. The Great Interior Valley is of a very complex morphology, with altitudes from 300 ms. to 1,000 ms.. The west end of the valley floor is the highest part, with altitudes ranging between 600 and 1,000 ms. above sea level, whence it slopes gently to the east where, near the Río Lempa, its elevation fluctuates between 300 and 600 ms..

Climate

El Salvador, at a latitude of 14° N., falls climatically into the sphere of the humid tropics and has, according to Köppen's classification, an Aw, or Tropical Savanna type of climate. The year is divided into two seasons of approximately six months each. Separated by periods of transition are a marked dry season called <u>verano</u>, and a wet season called <u>invierno</u>.[10] In Salvador the dry season coincides with the period of low sun, or winter. During this period the broadleaf plants, with the exception of the tropical rain forests in the coastal low lands and the high mountain peaks, drop their leaves and become dormant, giving the landscape a brown, dried out appearance. On the other hand the rainy season occurs during the period of high sun, or summer season. This is the main period of plant growth and the landscape assumes a beautiful green appearance.

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[10] The local names, <u>verano</u> meaning summer, and <u>invierno</u> meaning winter, originated with the early Spanish settlers, and are misnomers. In Spain, which has a Mediterranean type of climate, the dry season coincides with summer, whereas the rain comes during the winter season.

The Seasonal Rhythm of the Climate

April and most of May are the months of transition from dry to rainy season. Generally the rains start toward the last week in April, after the sun has passed its zenith, and the intertropical zone of convergence has moved north. This is the hottest season of the year. Sometimes the rains are late and the heat becomes unbearable, particularly in the low-lying areas along the coast. In May of 1961, I spent some time in San Miguel. Up to the third week no rain had fallen and the temperatures, ranging from 32°C. (89°F.) to 38°C. (100.5°F.), and coupled with a very high humidity, made life miserable at best. There are, however, exceptional years when heavy showers will occur in many parts of the country, releasing as much as 500 mms. (20 ins.) of precipitation. Thus the period of transition in which the days without precipitation out-number those with precipitation, may last from five to six weeks (see Table I). Normally the rainy season begins in the last days of May, and every third year not before June.[11]

TABLE I—DISTRIBUTION OF SEASONS

SEASON OF THE YEAR	BEGINNING	END	DURATION IN DAYS
Dry Season	Nov. 2	Apr. 20	170
Transition from dry to wet	Apr. 21	May 30	40
Wet Season	May 31	Oct. 11	134
Transition from wet to dry	Oct. 12	Nov. 1	21

Source: El Salvador, Ministerio de Defensa, Almanaque Salvadoreño 1961, San Salvador, 1961, p. 46.

[11] El Salvador, Ministerio de Defensa, Almanaque Salvadoreño 1961, San Salvador, 1961, p. 14.

The first rains come in the form of heavy showers accompanied by thunder storms. These are convectional showers of a relatively short duration and are interrupted in the beginning by one or more days of sunshine. Gradually their frequency and intensity increases until the days with rain out-number those without rain, during the early part of June. During this month there are, on the average, twenty days in which rain falls as convectional showers, but rain may also occur in the form of prolonged rain storms or <u>temporales</u>, releasing as much as 200 mms. (8 ins.) and more a day. At this time temperatures have dropped considerably due to a frequent cloud cover.

In July or August there is a slight decrease in amount of rainfall, but no decrease in the number of days with rain. A short dry season sets in, affecting the eastern part of the country in July and the western part in August. During this time cloud cover is reduced and the days are again extremely hot and humid. Locally, this period is called <u>canículas</u>.[12] Rains in this period occur mostly during late afternoon and night.

On August 16th, the sun again has crossed the zenith initiating a second rainy period which ends, in most parts of the country, by the middle of October, except in the east where the rains may last until the end of the month. September is the month of maximum precipitation throughout the country. Showers begin in early afternoon and increase steadily towards evening, the heaviest precipitation occurring from about six or seven in the evening until midnight (see Table II). This is the season when the dreaded <u>temporales</u> are most likely to occur

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[12] Canicular days, or dog days.

(see Table III). Temporales are caused by monsoonal conditions which bring moisture-laden south to south-west winds from the Pacific. The effect of these rains is felt most severely along the coastal mountains where orographic conditions force the air to release its moisture. During this period most of El Salvador's rivers attain flood proportions, causing widespread flooding and much damage to crops and loss of life. It is important to note that temporales greatly accelerate soil erosion which is already a grave problem in most parts of the country.[13]

TABLE II—DAILY DISTRIBUTION OF RAINFALL IN 1957

STATION	TIME AND PERCENTAGE OF TOTAL RAINFALL 00 - 06	06 - 12	12 - 18	18 - 24
San Salvador	21.4%	3.4%	19.0%	56.2%
Apopa	17.9	4.4	24.2	53.5
Santa Cruz Porrillo	16.8	6.4	12.8	64.0
Chorro de Guayabo	12.2	2.2	27.9	57.7

Source: El Salvador, Ministerio de Defensa, Boletin Meteorológico de El Salvador 1957, Nos. 1-13, Servicio Meteorologico Nacional, San Salvador, 1958, pp. 110-111.

TABLE III—NUMBER OF TEMPORALES FROM 1952 TO 1958

J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
0	0	0	0	2	4	1	0	7	6	1	0	21

Source: Same as Table I.

[13] For a more detailed description see: William Vogt, The Population of El Salvador and its Natural Resources, Washington, D.C., 1946.

By the middle of October the number of days with rainfall begins to diminish. However, temporales may still occur (see Table III). In October, 1957, a particularly strong temporal brought a record 246 mms. (9.8 ins.) to San Vicente within a twenty-four hour period, and more than 200 mms. (8 ins.) was recorded at six other stations.[14]

After a short period of transition, generally two to three weeks, the dry season commences in November. Isolated showers may still occur, but they are the exception and seldom produce more than 10 mms. (0.4 ins.) of rain.

Temperature

November to January is the coolest time of the year and the most pleasant. During this time the north-east Trades cross the mountain ranges of Honduras, bringing dry, cool air masses from North America. These cool air masses, or nortes, as they are called, are often accompanied by strong winds and sometimes by severe storms, particularly in the mountainous areas, and may last for as long as a fortnight. Days are pleasant with an abundance of sunshine, and are followed by cool nights. During January, minima of 8°C. (46.5°F.) have been recorded at the capital, and 5°C. (41°F.), in the Valley of San Andres. Although the nortes continue well into February, they begin to weaken. Long hours of sunshine raise daytime temperatures, but nights are still pleasantly cool. Throughout March, the temperatures climb, producing hot days with little wind. By the end of March a few rain showers begin to occur, increasing in intensity until the transitional stage to the rainy period begins again in April.

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[14] El Salvador, Ministerio de Defensa, Boletin Meteorologico de El Salvador, 1957, Nos. 1-13, Servicio Meteorologico Nacional, San Salvador, 1958, p. 77.

Distribution and Fluctuations in Rainfall

The average yearly rainfall of El Salvador lies somewhere between 1,800 mms. (72 ins.) and 2,000 mms. (80 ins.). From fourteen stations which were selected as being representative of the country as a whole, an average of 1,883 mms. (75 ins.) was obtained covering the period from 1914 to 1960 (see Table IV). During the same period the average maximum precipitation was recorded as 2,693 mms. (108 ins.) and the average minimum yearly precipitation at 1,241 mms. (50 ins.). Metapán recorded during the same period, the lowest absolute yearly rainfall with 798 mms (32 ins.), and Cojutepeque recorded the highest absolute yearly rainfall with 3,844 mms. (153.8 ins.). Most of the rainfall, or about 96 per cent, occurs between May 1st, and October 11th, with June and September receiving the heaviest precipitation (see Table IV). About 2 per cent of the precipitation occurs in the period of transition from wet to dry season between October 12th and November 1st, and 1.5 per cent falls in the transition period from dry to wet season, leaving about 0.5 per cent to the dry season, which has a duration of approximately 170 days.

The accompanying rainfall map (see Map IV) is based partly on data obtained from the Boletin Meteorologico de El Salvador for 1957, and partly on an unpublished map by Dr. H. Lessmann, the Chief Meteorologist in San Salvador. Due to lack of sufficient stations and reliable information, particularly for the northern regions, it is impossible to construct an accurate rainfall map. Most of the stations in the north on which the rainfall map is based have been in operation for less than five years, and the yearly records are not always


RAINFALL DISTRIBUTION
EL SALVADOR
Based on information from Weather Stations:
Data available more than 8 years
Data available less than 8 years
Rainfall in mm:
Below 1400 mm
1400 mm - 1600 mm
1600 mm 1800 mm
1800 mm 2000 mm
2000 mm 2200 mm
2200 mm 2400 mm
Above 2400 mm
SCALE
Kms
N
MONTE CRISTO
METAPAN
SAN JERONIMO
TEXIS JUNCTION
SANTA ANA
COATEPEQUE
CHALCHUAPA
ATIQUIZAYA
AHUACHAPAN
SONSONATE
ACAJUTLA
SAN ANDRES
ATEOS
SAN ANTONIO
COMASAGUA
SITIO DEL NIÑO
TALCIGUAYA
SAN SALVADOR
SANTA TECLA
SOYAPANGO
ILOPANGO
AGUILARES
COJUTEPEQUE
SAN VICENTE
STA CRUZ PORRILLO
SAN MARCOS LEMPA
USULUTAN
SAN MIGUEL (FICA)
OLOMEGA

MAP IV

TABLE IV—MONTHLY AND YEARLY AVERAGE RAINFALL (in millimeters)

YRS.	STATION	ELEV.	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
27	Metapán	465 ms.	1	4	13	44	181	304	239	228	323	175	12	8	1532
25	Santa Ana	646	3	2	6	62	227	334	330	319	389	194	33	8	1907
42	Sonsonate	225	2	3	6	47	193	339	300	299	358	324	28	9	1908
43	Acajutla	5	1	1	5	50	182	308	272	259	323	287	25	4	1717
21	Sitio del Niño	450	4	0	6	57	163	264	298	255	305	164	30	3	1549
27	La Toma (Aguilares)	305	4	4	5	51	201	325	347	324	384	189	30	5	1869
46	San Salvador	680	6	5	9	56	188	323	307	298	316	235	39	10	1792
30	Cojutepeque	800	3	1	9	48	201	389	392	357	363	276	37	7	2083
30	San Vicente	425	4	2	4	43	229	365	346	333	400	290	38	7	2061
30	Zacatecoluca	170	2	2	7	40	243	397	339	345	467	358	56	12	2268
30	San Marcos Lempa	20	1	0	2	26	180	308	311	302	417	347	52	6	1952
29	Usulután	70	1	1	3	18	207	353	293	284	390	354	46	6	1956
30	San Miguel	105	1	0	3	24	217	297	244	263	371	297	42	8	1767
30	Cutuco	5	1	0	6	28	270	366	190	264	472	347	50	8	2002

<u>Source:</u> Same as Table I.

complete.[15] However, certain patterns of rainfall can be observed. These patterns are closely related to the orography and indicate that in general, the mountains receive more moisture than the plains or lowlands.

Fluctuations of Temperatures and Climatic Zones

Due to its tropical location, El Salvador experiences a comparatively small range in yearly temperatures. On the basis of the statistics for the following eight stations (see Table V), covering a period from three to twelve years, the average temperature of the country is around 25°C. (77°F.), with a maximum of 32.1°C. (89.7°F.) and a minimum of 19.6°C. (67.3°F.). The average monthly temperatures fluctuate very little throughout the year and have a range of approximately 2.3°C. (3.6°F.), which is considerably less than the monthly ranges which reach their peak in February (see Table VI).

Aside from the normal seasonal changes in temperature, the effect of elevation on temperature is an important factor in the tropics. On the basis of elevation, three climatic zones can be distinguished: (see Map V)

1. Tierra Caliente - 0-800 ms. above sea level. This climatic zone comprises more than 80 per cent of the land area of El Salvador, and can be further subdivided on the basis of temperatures which range between 22°C. (71.6°F.), and 29°C. (84.4°F.).

a. Coastal Plains, below 100 ms., have a temperature

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[15] Pers. comm. Dr. H. L. Lessmann, San Salvador. Dr. Lessmann pointed out that at one of the stations they lost two operators within a three year span, by death due to fights after drunken orgies.

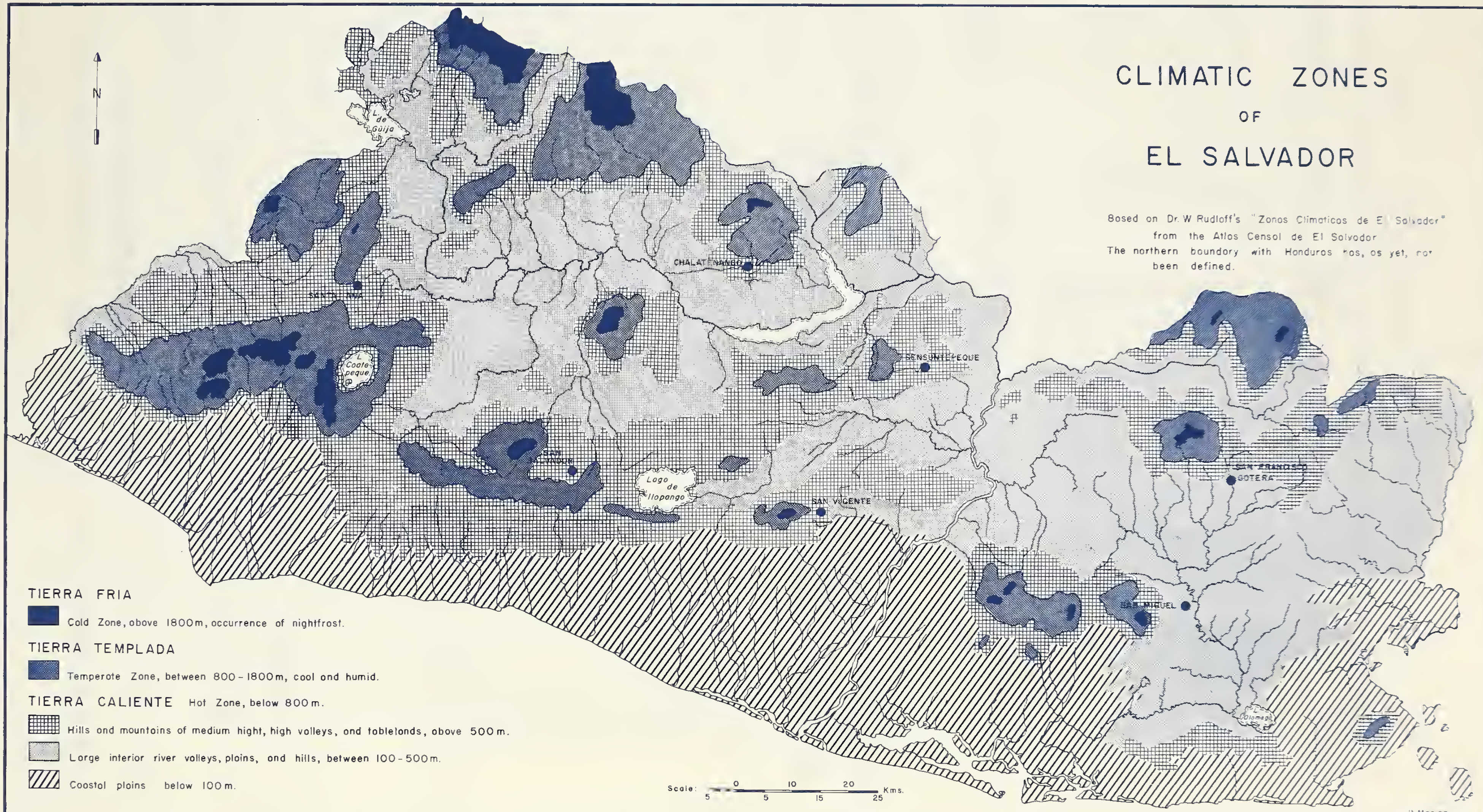
CLIMATIC ZONES
OF
EL SALVADOR
Based on Dr. W. Rudloff's "Zonas Climaticas de El Salvador"
from the Atlas Censal de El Salvador
The northern boundary with Honduras has, as yet, not been defined.
N
L. de Güija
SANTA ANA
L. Coatepeque
CHALATENANGO
SENSUNTEPEQUE
Lago de Ilopango
SAN VICENTE
SAN FRANCISCO GOTERA
SAN MIGUEL
L. Olomega
TIERRA FRIA
Cold Zone, above 1800 m, occurrence of nightfrost.
TIERRA TEMPLADA
Temperate Zone, between 800 - 1800 m, cool and humid.
TIERRA CALIENTE Hot Zone, below 800 m.
Hills and mountains of medium hight, high valleys, and tablelands, above 500 m.
Large interior river valleys, plains, and hills, between 100 - 500 m.
Coastal plains below 100 m.
Scale: 5 0 5 10 15 20 25 Kms.
D. Mosing

TABLE V—AVERAGE ANNUAL TEMPERATURES (° Celsius)

STATION	ELEV.	AV.AN MAX.	AV.AN MIN.	AV. AN.	ABS. MAX.	ABS. MIN.
Acajutla	5 ms.	31.7	22.4	26.8	39.0	13.8
Santa Cruz Porrillo	30	34.6	21.0	27.0	42.4	10.6
San Miguel	105	35.5	21.5	27.3	44.8	12.2
Chorrera de Guayabo	190	34.2	21.3	26.8	40.4	12.7
Izalco	380	31.9	20.1	24.6	37.5	14.0
San Andres	475	31.9	16.8	24.2	38.7	5.0
San Salvador	700	29.4	17.5	22.7	35.3	8.3
Santa Tecla	955	28.1	16.3	21.2	34.3	7.9
		32.1 (89.7°F.)	19.6 (67.3°F.)	25.0 (77.0°F.)		

Source: Same as Table I.

TABLE VI—TEMPERATURES FOR SAN SALVADOR FOR 1957 (° Celsius)

MONTH	AVERAGE MAXIMUM	AVERAGE MINIMUM	MONTHLY RANGE [a]	AVERAGE MONTHLY TEMP.
January	29.3	15.3	16.5	21.8
February	30.8	16.1	19.3	22.9
March	31.7	16.6	18.3	23.3
April	31.7	18.2	16.9	24.0
May	30.5	18.9	15.1	24.0
June	29.3	18.8	15.1	23.3
July	29.9	18.2	13.8	23.3
August	30.1	18.1	13.7	23.2
September	28.7	18.1	14.1	22.4
October	27.7	17.6	13.0	22.4
November	29.0	16.9	14.8	22.8
December	28.1	16.2	16.4	21.7

[a] The monthly range was calculated on the basis of daily absolute maximum and minimum values.

Source: Same as Table II.

ranging from 27°C. (80.6°F.) to 22°C. (71.6°F.).

b. Higher Interior Plains and Valleys, between 100 ms. and 800 ms., with temperatures ranging between 29°C (84.4°F.), and 23°C. (73.6°F.).

2. Tierra Templada - 800-1,800 ms. above sea level. This climatic zone covers approximately 17 per cent of the country, and has

temperatures ranging between 23°C. (73.6°F.) and 16°C. (60.8°F.). Precipitation increases with elevation and the amount of rainfall varies between 1,700 mms. (68 ins.), and 2,000 ins.) during the year.

3. Tierra Fria - 1,800 ms. and above. The temperatures of this area, which comprises approximately 3 per cent of the country, taking in the high mountain peaks of the Cadena Costera and the peripheral mountains of northern El Salvador, fluctuate between 16°C. (73°F.) and 10°C. (50°F.), but during the dry season nocturnal frosts may occur. The rainy season in these higher mountain areas is generally longer than in the lowlands and has a duration of eight to ten months, with precipitation well above 2,000 mms. (80 ins.). The limits between these climatic zones are determined not only from temperature and rainfall, but to a large degree from natural vegetation and limits of cultivation for particular crops.

Water

El Salvador's more than 360 rivers may be arranged into three groups on the basis of length, volume, and drainage area. The Rio Lempa is not only the largest and most important river of El Salvador, but also the largest Central American river draining into the Pacific Ocean (see Figure 8). Of its overall length of 350 kms.,[16] 295 kms. traverse the Republic, draining an estimated area of 10,050 sq. kms., of

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[16] There is a considerable discrepancy between the Diccionario Geografico of the Republic of El Salvador for the year 1959, and author Gierloff-Emden, regarding the length of El Salvador's rivers. Believing Gierloff-Emden to be more accurate, I have relied on his figures.

Fig. 7.--The coastal plains are composed largely of volcanic materials. Shoreline near Acajutla.

Fig. 8.--The Cuzcatlan Bridge spans the Rio Lempa, the largest Central American river draining into the Pacific.

50.25 per cent of the total national territory.[17] The second group consists of the Río Grande de San Miguel, with an approximate length of 145 kms., the Río Goascorán with 125 kms. (see Figure 9), and the Río de Paz, estimated at about 110 kms.. Together these three rivers drain 4,532 kms.^{2}, or 22.7 per cent of the country's total area. The third group takes in the numerous short coastal rivers, ranging in length from 5 to 40 kms., draining an estimated area of 5,258 kms.^{2}, or 26.75 per cent. This last group includes also the interior drainage basin of the Lago de Coatepeque, an area of approximately 60 kms.^{2}, or 0.3 per cent of the total national territory (see Table VII, and Map VI).

The flow of streams fluctuates during the year, closely reflecting the seasonal distribution and amount of rainfall. Indiscriminate destruction of the vegetative cover in the watershed areas (see Figures 10 and 11), for firewood or milpas, and consequent erosion have caused excessive run-off, particularly during the heavy temporales. This has had disastrous effects on the hydrologic regime. Stream flow is extremely irregular. Flash floods may arise within minutes after a heavy shower, causing considerable damage to property and loss of life.

As a result of rapid run-off the water table is gradually being lowered throughout the country. During the long dry season stream flow is sustained by spring discharge only, as little or no rainfall occurs, and there is an annual problem of water supply in many parts of the

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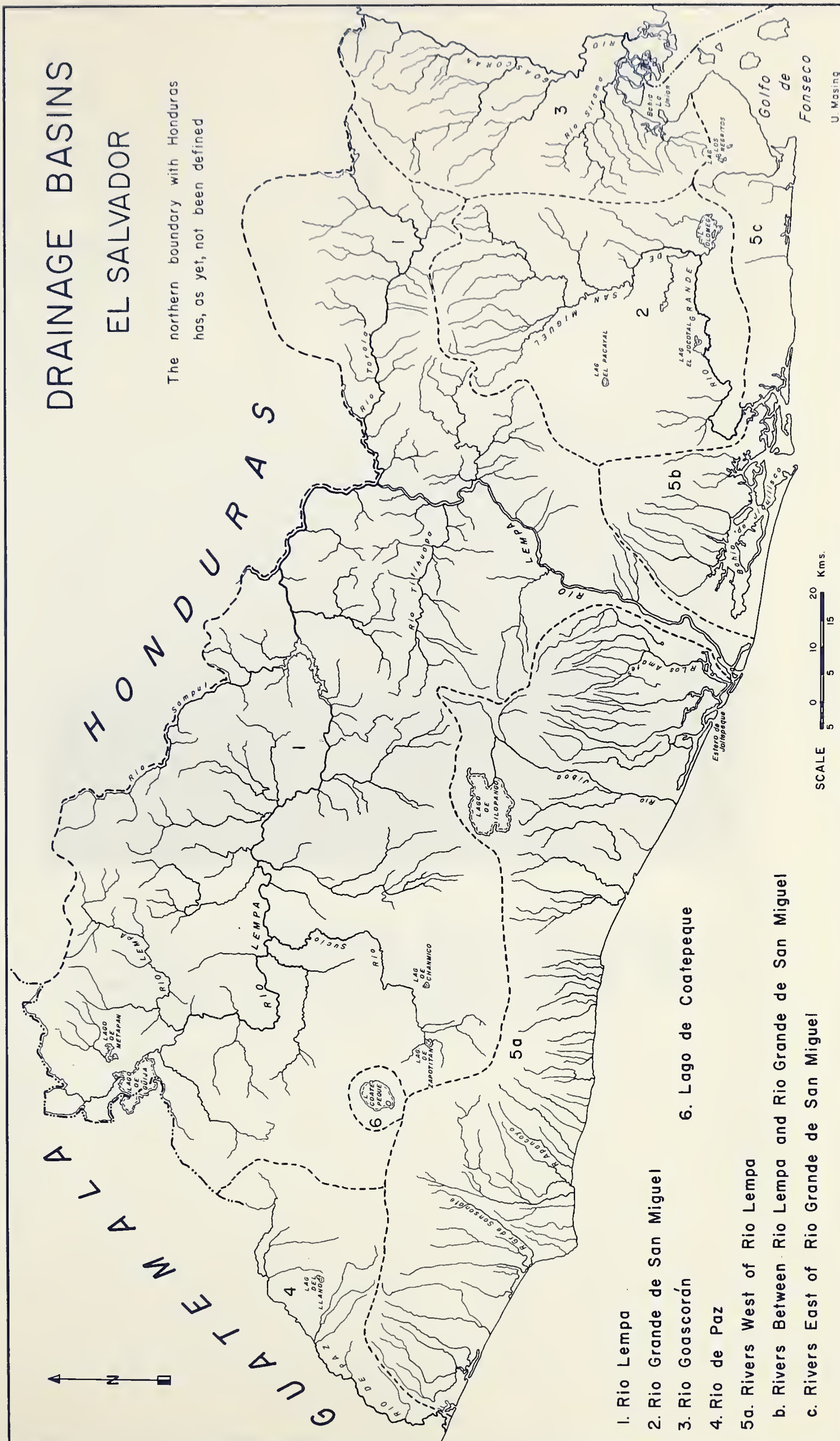
[17] H.G. Gierloff-Emden, Erhebungen und Beiträge zu den physikalisch-geographischen Grundlagen von El Salvador, Bonn, 1958, p. 68. Gierloff-Emden was the first to calculate the area for the drainage basin of El Salvador from air photos and topographic sheets on the scale of 1:40,000.


DRAINAGE BASINS
EL SALVADOR
The northern boundary with Honduras has, as yet, not been defined
HONDURAS
GUATEMALA
Golfo de Fonseco
U. Masing
1. Rio Lempa
2. Rio Grande de San Miguel
3. Rio Goascorán
4. Rio de Paz
5a. Rivers West of Rio Lempa
b. Rivers Between Rio Lempa and Rio Grande de San Miguel
c. Rivers East of Rio Grande de San Miguel
6. Lago de Coatepeque
SCALE
Kms.
Rio Lempa
Rio Sumpul
Rio Torola
Rio Titihuapa
Rio Sucio
Rio Goascorán
Rio Sirama
Rio Grande de San Miguel
Rio Jiboa
Rio Los Amates
Rio de Paz
Rio Grande de Sonsonate
Bahia de Jiquilisco
Bahia La Union
Estero de Jaltepeque
Lago de Ilopango
Lago de Metapan
Lago de Güija
Lag de Chanmico
Lag de Apopitán
Lag del Llano
Lag El Pacayal
Lag El Jocotal
Lag El Olomega
Lag Los Negritos
Coatepeque
Acajutla
5a
5b
5c
1
2
3
4
6

MAP VI

Fig. 9.--Rio Goascoran during the dry season. Looking north from Puente Goascoran. Note the galeria forest typical of most of the country's rivers. The volcanic neck to the right is in Honduras.

TABLE VII--DRAINAGE BASINS OF EL SALVADOR

	DRAINAGE BASINS	LENGTH OF RIVERS IN KMS.	AREA DRAINED IN KMS.	PERCENTAGE OF TOTAL AREA
I.	Drainage Basin of Río Lempa	350	10,050	50.25
II.	Drainage Basin of Río Grande de San Miguel	145	2,299	11.50
III.	Drainage Basin of Río Goascoran and northern Fonseca Bay	125	1,443	7.25
IV.	Drainage Basin of the Río de Paz	110	790	3.95
V.	Coastal Drainage Basins:			
	a. Rivers west of Río Lempa	10-40	4,158	20.75
	b. Rivers between Río Lempa and Río Grande de San Miguel	5-20	610	3.10
	c. Rivers east of Río Grande de San Miguel	5-20	590	2.90
VI.	Interior Drainage Basin of Lago de Coatepeque	---	60	0.30
			20,000 kms.[2]	100.00

Source: Gierloff-Emden, Erhebungen und Beiträge zu den physikalisch-geographischen Grundlagen von El Salvador, Bonn, 1958, p. 68.

Republic. Thus during the dry season many rivers dry up completely, whereas others diminish to a mere trickle (see Figures 9, 12, and 13). The seasonal distribution of rainfall also affects the condition of the water table, which reaches its highest levels at the end of the rainy season, while the lowest stages occur toward the end of the dry season. These conditions will, however, vary from year to year, depending on the total amount of rainfall.

During the rainy season the rivers swell to impassable torrents. Measurements taken at La Pintada, on the Río Lempa,[18] reveal an average discharge of 348 cu. ms. per second. The absolute maximum for the Río Lempa was measured at Chorro de Guayabo[19] in 1934, registering a discharge rate of more than 15,000 cu. ms. per second. This was the direct result of a hurricane which had crossed the Cordillera from the Caribbean Sea, an occurrence which is very rare, releasing as much as 500 mms. of rainfall over large areas of the country within a forty-eight hour period, causing widespread floods and damage to crops and loss of life. In normal years the lowest flow occurs during the dry season, from December to May, and is below 100 cu. ms. per second (see Figure 14).

From the middle of May to the middle of November, the stream flow fluctuates with the individual amounts of rainfall. Due to the increased occurrence of <u>temporales</u> (see Table III) in September and October, the average maximum discharge at La Pintada ranges between 3,000 and 4,000 cu. ms. per second over a short period.

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[18] Gierloff-Emden, <u>op. cit.</u>, p. 78. La Pintada is located approximately 15 kms. north of the Cuzcatlán Bridge connecting the Pan American Highway across the Río Lempa.

[19] Chorro de Guayabo is situated at the east end of the reservoir on the Río Lempa.

Fig. 10.--Milpas on slopes of 70 per cent and steeper have been planted along the road to Ciudad Barrios, causing accelerated erosion and landslides during the rainy season.

Fig. 11.--Denuded hills still used for milpas in the Jucuarán Mountains north-west of Intipucá.

Fig. 12.--During the long dry season stream flow is sustained only by spring discharge as little or no rainfall occurs.

Fig. 13.--Many rivers dry up completely, whereas others diminish to a mere trickle. Rio Pasaquina taken from the bridge looking west. Note the galeria forest along the river.

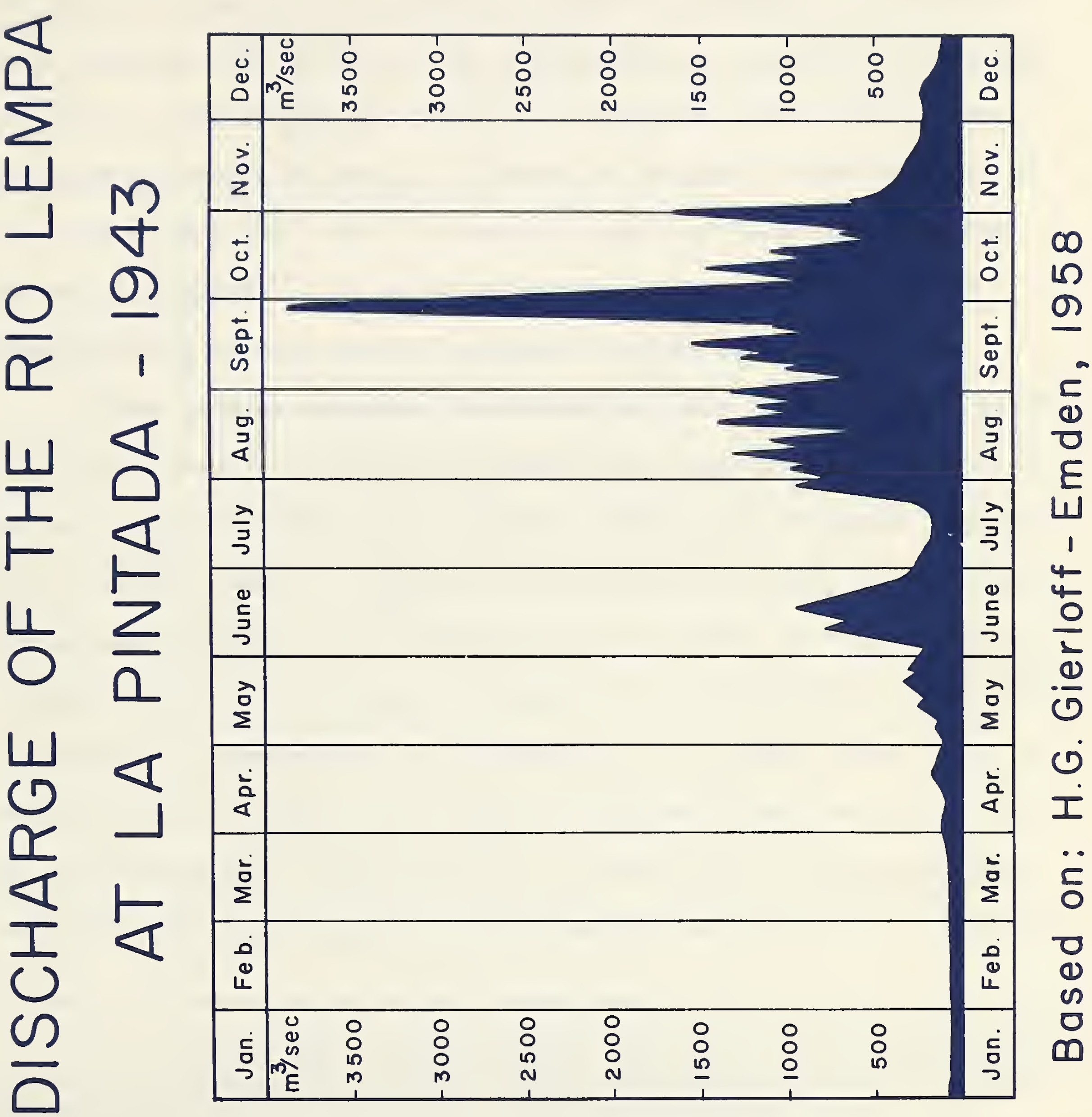
DISCHARGE OF THE RIO LEMPA
AT LA PINTADA - 1943
m^3/sec
3500
3000
2500
2000
1500
1000
500
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Based on: H.G. Gierloff-Emden, 1958

Fig. 14

With an increase in flow during the rainy season, there is also an increase in the amount of sediment carried by the rivers, for the capacity of a river depends on the volume and speed of flow. Meyer-Abich[20] reports on the findings of the Harza Engineering Company, which calculated the annual sediment load at Chorro de Guayabo, as being 1 gm. per liter, at a discharge rate of 172 cu. ms. per second, for a period of 363.8 days of the year, and 18 gms. per liter, at a discharge rate of 725 cu. ms. per second during 1.25 days, or 30 hours of the year. Meyer-Abich is of the opinion that the load of 18 gms. per liter has been calculated for too short a period.[21] It can be assumed that this pattern is fairly representative of most rivers throughout the Republic.

Almost without exception the cities and towns of El Salvador obtain their water supply for public and domestic use from springs and wells.[22] In the mountainous regions and highlands, springs are the chief source of water supply. Due to a lowering of the water table during the dry season, the springs on higher levels usually dry up and those on lower levels are considerably reduced in flow. An example from the department of Cuzcatlan should serve to demonstrate the fluctuation of the ground water table between dry and wet season. The town of San Rafael Cedros has a water supply of approximately 75,000 gallons a day during the rainy season, compared with only 7,000 gallons a day during the dry season, or a discharge

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[20] H. Meyer-Abich, "Considerationes Geologicas Acerca de la Planta Electrica Proyectada en el Lugar 'Chorrera del Guayabo' en el Rio Lempa", Comunicaciones del I.T.I.C., No. 1, San Salvador, 1952, p. 4.

[21] Loc. cit..

[22] A.N. Sayre, and G.C. Taylor, "Ground Water Resources of the Republic of El Salvador, Central America", Geological Survey, Water - Supply, Paper 1079-D, Washington, D.C., 1951. p. 156.

of approximately 50 gallons a minute in the wet season compared with about 5 gallons a minute during the dry season.[23]

In some parts of the country, the water table of wells dug for domestic and municipal use will fluctuate annually through a range of 15 to 20 ft., with seasonal variations in rainfall. Thus the effect of deforestation and consequent erosion which results in a constantly falling water table and the resulting decrease in water supply may well be one of El Salvador's most serious problems in the future.

Natural Vegetation

Of the natural vegetation that once covered most of El Salvador (see Map VII), little remains but a few small remnants.[24] Through generations of use and misuse, the natural cover has been almost completely destroyed over large parts of the country and greatly changed in others. Vestiges of the original vegetation now cover only those areas which are of little economic value, or which are difficult to reach. According to an estimate by the Ministry of Agriculture in 1952, timber reserves of commercial quality throughout the Republic amounted to only 164 sq. kms..

Due to its climate with pronounced wet and dry seasons, El Salvador's vegetation is mainly mesophytic. True xerophytes and hydrophytes are rare. Temperature and humidity are the two important elements in

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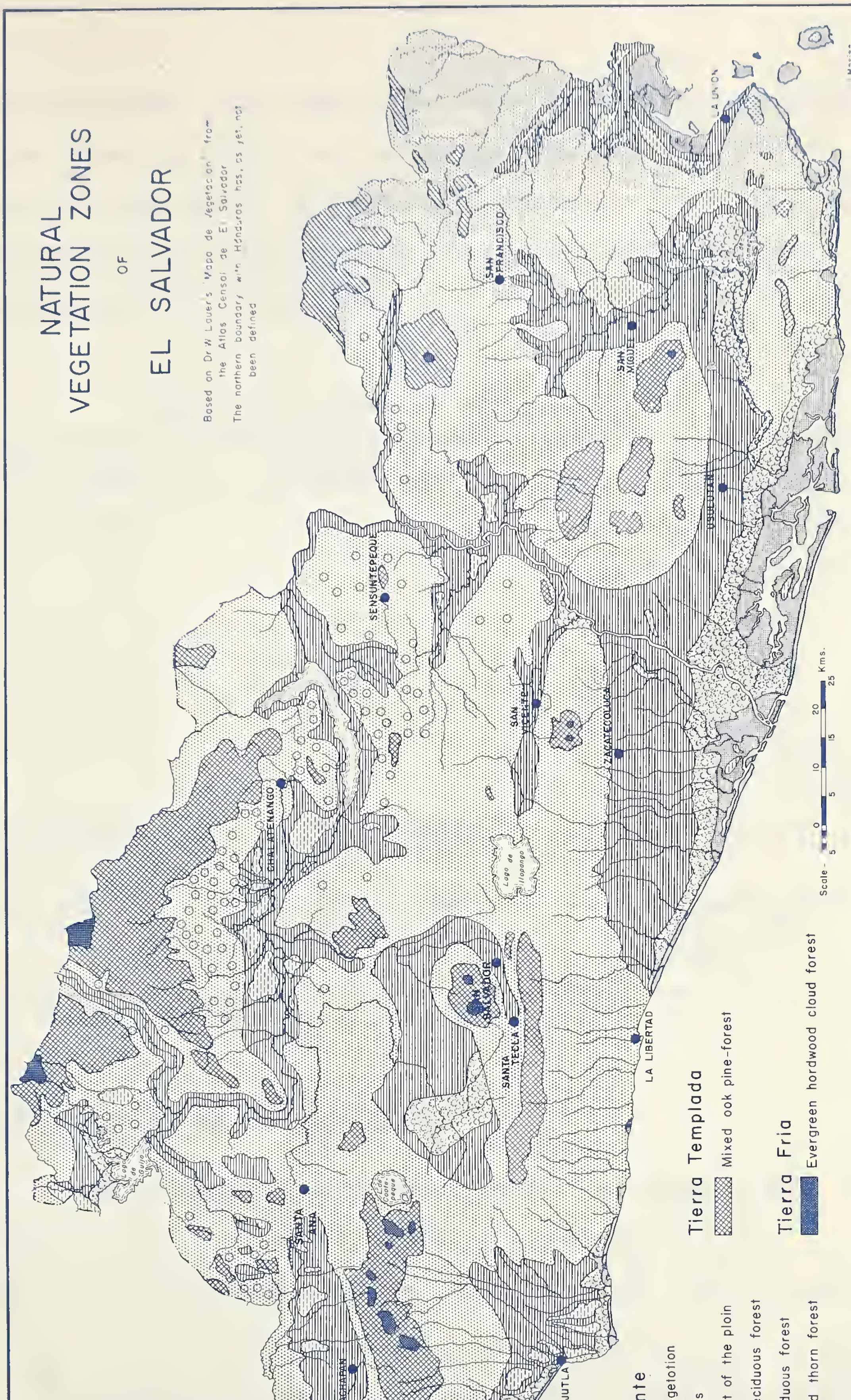
[23] Sayre & Taylor, op. cit., p. 194. Sayre and Taylor give a discharge of 100 gals. per minute during the rainy season, which I believe to be either an error or oversight, because a discharge of 100 gals. a minute would give a water supply of 144,000 gals. a day, as compared with a discharge of 50 gals. a minute which would more nearly approximate 75,000 gals. a day.

[24] W. Lotschert, "La Sabana de Morros de El Salvador", Comunicaciones del I.T.I.C., Nos. 5-6, San Salvador, 1953, p. 122.


NATURAL VEGETATION ZONES OF EL SALVADOR
Based on Dr W Lauer's 'Mapa de Vegetacion' from the Atlas Censal de El Salvador
The northern boundary with Honduras has, as yet, not been defined
Tierra Caliente
Beach vegetation
Mangroves
Wet forest of the plain
Humid deciduous forest
Dry deciduous forest
Scrub and thorn forest
Chaparral
Tierra Templada
Mixed oak pine-forest
Tierra Fria
Evergreen hardwood cloud forest
Scale - 5 0 5 10 15 20 25 Kms.
AHUACHAPAN
SANTA ANA
ACAJUTLA
CHALATENANGO
SAN SALVADOR
SANTA TECLA
LA LIBERTAD
Lago de Ilopango
SENSUNTEPEQUE
SAN VICENTE
ZACATECOLUCA
USULUTAN
SAN MIGUEL
SAN FRANCISCO
LA UNION

MAP VII

the life of plants, and strongly affect their areal patterns of distribution. These are further modified by topography, soil, and availability of ground water. On the basis of temperature and rainfall, the following types of vegetation can be distinguished within the three climatic zones[25] (see Table VIII).

TABLE VIII--PATTERNS OF NATURAL VEGETATION

CLIMATIC ZONE	ALTITUDE (in ms.)	VEGETATION
Tierra Caliente	0 - 800 (1,000)	a. beach vegetation b. mangroves c. wet forest of the plain d. humid deciduous forest e. dry deciduous forest f. chaparral g. scrub and thorn forest (Savanna)
Tierra Templada	800 - 1,800 (1,000 - 2,000)	a. mixed oak-pine forest
Tierra Fria	1,800 and above (2,000 and above)	a. evergreen hardwood cloud forest

Source: Lötchert, op. cit., p. 122.

The Vegetation of the Tierra Caliente

The upper limits of the natural vegetation pertaining to this climatic zone fluctuate between elevations of 800 and 1,000 ms.. Along the Pacific coast two types of vegetation occur. These are the

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[25] Lötschert, op. cit., p. 122; and W. Lauer, Vegetation, Landnutzung und Agrarpotential in El Salvador, Kiel, 1956, p. 19.

coarse grasses of the sandy beach terraces, and the mangrove forests along the estuaries, bays and river mouths. The wood of the mangrove is used for burning and building, particularly in the government-owned salt works which use large quantities of firewood. According to Lauer[26] the mangroves are the only State forests in the country, and thus there is an attempt to curtail their misuse by law. Aside from their wood, the mangroves are of no use.

The lower coastal plains, river valleys, and low plains of the interior that have an abundance of ground water throughout the year, were at one time covered with an hydrophytic forest called wet forest of the plain,[27] which has a close resemblance to a tropical rain forest, rich in species, and with intensive growth. Locally this forest is known as the _bosque de ojushte y huiscoyol_ after the more dominant species of trees, the _ojushte_ (_Brosimum terrabanum_), and the _huiscoyol_ (_Bactris subglobosa_), a spiny-leaved palm. Aside from these, there are numerous other species of trees: the _hule_ (_Castilloa gummifera_), the rubber tree of El Salvador, the _carreto_ (_Pithecollobium saman_), which is used in the manufacture of ox cart wheels, the _bálsamo_ (_Myroxylon pereiras_), from which the famous Balsam of Peru is extracted, and many others.

During the rainy season, these forests often turn to swamps, and are impossible to penetrate. Underneath the trees, many of which reach heights of 100 ft. and more, flourishes a dense undergrowth of spiny palms (_Bactris subglobosa_), and other brush vegetation which adds to the difficulty of penetration. Lauer indicates that the trees change

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[26] Lauer, _op. cit._, p. 44.

[27] Lötschert, _op. cit._, p. 127.

their foliage throughout the year, with each species following its own seasonal rhythm so that even during the dry season some trees will be in foliage.

Among the better-known trees are the amate, or wild fig (Ficus spp.), which is by many considered to be the national tree of El Salvador. The amate is represented by many species, and is found in almost every village or town (see Figure 15), where it is used as a shade tree, and much of the life of the villager is spent underneath its broad crown. Another tree is the ceiba (Ceiba pentandra), the tallest tree in the country. The fruits of the ceiba are surrounded by silk-like fibers known as kapok, which is used for the stuffing of pillows.[28]

Today these forests are increasingly giving way to cotton and pasture land. In the summer of 1961, I observed that large areas were being deforested (see Figure 16) for the planting of cotton, and it seems to be only a matter of time before these forests will completely disappear, for this is some of the best agricultural land in El Salvador.

Penetrating from the coast to the interior along the river valleys, are the galeria forests (see Figure 17). During the dry season they occur as green ribbons, giving definite character to the surrounding landscape. In the more densely populated areas the need for construction and fire wood has eliminated much of the primary galeria forests, leaving a secondary growth heavily infested with thorny bushes

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[28] P.C. Standley, The Republic of Salvador, from the Smithsonian Report for 1922, Washington,D.C., 1924, p. 323.

Fig. 15.--An amate tree, the common shade tree of Central America, found in almost every village or town.

Fig. 16.--Wet forest of the plains along the Rio Lempa giving way to cotton.

of which the acacias are the most common.

In the seventeenth century most of El Salvador was covered by a semi-humid deciduous forest. Vazquez de Espinosa,[29] in his travels in the early seventeenth century, makes constant reference to the abundance of forests throughout El Salvador. Generations of burning, overgrazing, and plow cultivation have diminished these forests to near extinction. Uncontrolled cutting and lack of government reforestation programs until fairly recently, accompanied by a system of land-holding (see Chapter V), which has brought about the cultivation of steep hillsides, has not only eliminated the primary forests, but has prevented the growth of a secondary forest as well. Through constant cutting and burning the soil has been eroded and the water table lowered to a point where a forest can no longer establish itself.[30] The resulting vegetation is a chaparral bush.

Small stands of the original trees have been left as shade trees on cultivated pasture land (see Figure 18), giving it the appearance of a savanna.[31] Scherzer, in his travels in 1854, makes reference to the sparse forest cover throughout the interior of the Republic.[32] Here too, the tall ceiba trees are a common sight.

The chaparrales, of which the Curatella americana is the most common species, reach heights of 10 to 30 ft.. The areas originally covered by these trees were rocky and characterized by the absence of a

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[29] A. Vazquez de Espinosa, Compendio y Descripción de las Indias Occidentales, Washington, D.C., 1948, pp. 210-218.

[30] Lauer, op. cit., p. 36.

[31] Ibid., p. 38. According to Lauer, there are no natural savannas in all of Central America, all savannas being man-made, or kultursavannen.

[32] C. Scherzer, Wanderungen, Braunschweig, 1957, p. 473.

Fig. 17.--Penetrating from the coast to the interior along the river valleys are the galeria forests. During the dry season they occur as green ribbons, giving definite character to the surrounding landscape.

Fig. 18.--Small stands of original trees have been left as shade trees on cultivated pasture lands giving it the appearance of a savanna.

well-developed humus layer in the soil and readily available ground water. The undergrowth is normally a sparse cover of grasses, and as everywhere else, here too, the thorn bushes have penetrated due to over-grazing, and the formerly dense growth has taken on a savanna-like appearance. Lauer[33] observed that the chaparral migrates down slope from denuded hills where the soil and the natural cover has been completely destroyed. Because of its resistance to fire and adaptability to extremely poor growing conditions, the chaparral has taken over large areas formerly covered by semi-humid deciduous forests. It must be stressed that this is not due to changes in climate, but rather to changes in soil cover and the level of the water table, resulting from mis-management of the land.

Another vegetation complex adapted to extremely poor growing conditions is the scrub and thorn forest, called morral, and jicaral, after the two most common species, morro (Cresentia alata), and jicaro (C. cujete). These prefer an impermeable clay soil, remnants of old lake beds, and river terraces. In the past these stands were almost impenetrable in the rainy season because of the bog-like conditions due to the impermeability of the soil and the presence of thorny underbrush, but today the stands are much more dispersed as a result of grazing practices. The grass cover is very sparse, but considered to be very nutritious. During the dry season the morrales, as well as the chaparrales shed their leaves, thus giving the landscape a brown, drab appearance (see Figures 19 and 20).

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33 Lauer, op. cit., p. 43.

Fig. 19.--Another vegetation complex adapted to the extremely poor growing conditions is the thorn and scrub forest called morral and jicaral. These prefer an impermeable clay soil, remnants of old lake beds and river

Fig. 20.

terraces. During the dry season they lose their leaves giving the landscape a drab appearance.

The Vegetation of the Tierra Templada

Above the upper limits of the tierra caliente, the change in vegetation cover becomes apparent. This change may be obscured along the volcanoes of the Cadena Costera because of the coffee plantations, which in places may extend from the tierra caliente.

The dominant natural vegetation in the tierra templada is a mixed oak-pine forest. Lauer[34] distinguishes twelve species of oak (*Quercus* spp.), and only one species of pine (*Pinus oocarpa*). In the past these forests contained numerous other species as well, of which remnants can still be found on the Cerro Cacaguatique, among the oak and pine forests. At present the government is trying to promote a program of reforestation to prevent the complete destruction of valuable watersheds through indiscriminate use (see Figures 21 and 22).

The Vegetation of the Tierra Fria

Characterized by dense evergreen hardwood cloud forests, of which the oak is the most representative species, reaching heights of 60 to 100 ft., this zone lies above an altitude of 2,000 ms. and receives an abundance of precipitation throughout the year, with the exception of a shorter-than-usual dry period in which the moisture is supplied by an almost daily cloud cover and dense fog. These are the only forests of El Salvador that have been relatively little-touched.

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[34] Lauer, *op. cit.*, p. 28.

Fig. 21.--The dominant natural vegetation in the Tierra Templada is a mixed oak-pine forest. Cerro Cacaguatique, seen from the patio of the coffee beneficio San Carlos.

Fig. 22.--The Government is trying to promote a program of reforestation to prevent the complete destruction of valuable watersheds through misuse.

Soils

To date very little has been published about the soils of El Salvador and what exists is very generalized, referring to soils as either "fertile" or "infertile", or describing them as "white" or "red" soils. Most geographic and other literature on El Salvador, fails to take soils into account. Thus, Lauer's work on the vegetation and land use of El Salvador makes no reference to soils.

The reason for this is that until very recently little work had been done in the field of soil studies in El Salvador. However, the Ministry of Agriculture is at present preparing a series of soil maps on a scale of 1:50,000 which will eventually cover the entire country. A number of these maps have already been published, and discussion on soils in this paper is largely based on the few soil maps now available.[35]

The classification of the soils of El Salvador presents certain difficulties for most of them are very young and lack well-developed horizons. All of El Salvador is underlain by volcanic materials of different geologic age. The mountains of the north as well as the Great Interior Valley and the Jucuáran Coastal Mountains, date back to the Tertiary while the Cadena Costera and the coastal lowlands are of Pleistocene origin.

There is a tendency in nature to provide an equilibrium between the parent material, climate, vegetation, and slope, the soil-forming factors and the soil. In El Salvador this tendency has been repeatedly

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[35] The following quadrangles were available: 2555 I Olomega, 2556 I Jocoro, 2556 II San Miguel, 2556 III Usulután, 2655 IV Conchágua, 2656 III La Union, 2656 IV Santa Rosa de Lima.

interrupted by volcanic disturbances. Since there is very little level land, few soils have developed to maturity. Accelerated erosion is continually removing developed soil from its place of origin to deposit it elsewhere. As a result, few soils have developed mature profiles except those formed under continuous forest or grass cover.

Man has added the greatest share to this disturbance of Nature's balance. At one time all of El Salvador was probably under forest cover. With a rapid increase in population the forest gradually gave way to agricultural land use. The milpa system of agriculture and the introduction of the plow have not only destroyed almost all of the country's natural vegetation but also completely destroyed large areas for any agricultural use for generations to come (see Figures 23 to 28). With each rain new landslides appear on the steep slopes and each cycle of burning, planting, and abandoning of the milpa leaves the already poor soil more exhausted and closer to the underlying bedrock.

The milpa system has not been the only reason for the rapid erosion in large parts of the country. The use of wood in mines is largely responsible for the desert-like conditions in the districts of San Francisco Gotera and Santa Rosa, and probably much of the Metapán area. Plowing up and down steep hills and burning the fields after harvest have also added to acceleration of erosion throughout the country.

Most of the soils of El Salvador fall into the following groups: regosols, latosols, brown forest soils, lithosols, and grumosols. The latosols are considered to be the zonal soils of the country. They were formed under forest cover and as a rule from basalts and andesites or the alluvium of these. Most of them are red clay soils covering large parts of the Interior Valley and the slopes of the volcanoes and coastal mountains. On the lower slopes and more level lands they are

Fig. 23.-- The milpa system of agriculture and the introduction of the plow have not only destroyed most of the country's natural vegetation but also large parts of the country for any agricultural use for generations to come.

Fig. 24.--Plowing up and down on slopes adds to the accelerated erosion which is a great problem throughout the country.

Fig. 25.-- Accelerated erosion near Intipuca, south of the littoral highway. Note the milpas on the upper slopes in the background.

Fig. 26.--A common sight throughout the Republic. Corn is still planted amidst the exposed rocks and debris until nothing is left but the bare rock.

Fig. 27.--View north into the canyon leading to Ciudad Barrios. Note the exposed slopes with milpas.

Fig. 28.--Milpas along the littoral highway west of Zacatecoluca.

generally well developed, deep, fine-textured clays, with blocky structure and slightly plastic and sticky. On steeper slopes these soils tend to be very stony and shallow. Due to their fine texture they are very vulnerable to erosion. They are generally considered to be moderately fertile but their use for intensive mechanized agriculture is often limited due to steepness of slope, shallowness and stoniness.

The brown forest soils form under a forest cover on the higher slopes of the Pleistocene volcanoes from recent volcanic materials, particularly volcanic dust and pumice. The 'A' horizon tends to be rich in humus and slightly acid, giving the upper horizon a darker color. The texture may vary from loam to clay loam. These soils have a very good water storage capacity and are considered to be very fertile.

The most representative soils of the country are the regosols. They develop from wind and water deposited volcanic materials along the coastal plains, piedmonts, and flood plains. These soils lack well-developed profiles, and often reach depths of 20 ms. and more, over-lying older soils which have been covered by recent volcanic deposits. Along the coast and on the piedmonts, the regosols are generally deep, fertile soils with good water storage capacity. They are usually medium textured clay loams or clays and are regarded as the best agricultural lands of the Republic.

Lithosols are common along the steep mountain slopes devoid of vegetation and along river valleys where loose rock provides the parent material. They are shallow soils without any well-developed horizons, and are very stony.

Another of the poorly developed soils are the grumosols. These black to gray clay soils are found on almost completely flat and poorly

drained locations. They are extremely plastic, sticky when wet, and crack deeply when dry. Some occur on bottom lands while others are associated with shaley subsoils. Neither the grumosols nor the lithosols are of value to intensive mechanized agriculture. The natural vegetation cover of the grumosols is a thorn and scrub savanna locally known as morral (see Figures 19 and 20) while the lithosols tend to be more suited for chaparral.

CHAPTER II

HUMAN ELEMENTS

Pre-Columbian El Salvador

Little is known about the earliest history of the Pre-Columbian Period. However, from the multitude of conflicting speculations and accounts, certain facts are discernable. By the time the Conquistadores set foot in Central America, almost all of the territory which today constitutes the Republic of El Salvador, was occupied by two principal groups of people -- the Pipil and the Lenca[1] (see Map VIII).

The Pipil, descendants of the Toltec who had migrated over a period of time from Mexico, occupied El Salvador as far east as the Rio Lempa, and were organized in a loose federation of tribal groups (cacicazgos) under the leadership of the lordship (señório) of Cuzcatlan.[2] The Lencas occupied the territory east of the Río Lempa, called Chaparrastique, and parts of northern central El Salvador. Of their social organization little is known, but it would appear that they too, had a loose federation of tribal groups under the leadership of caciques.

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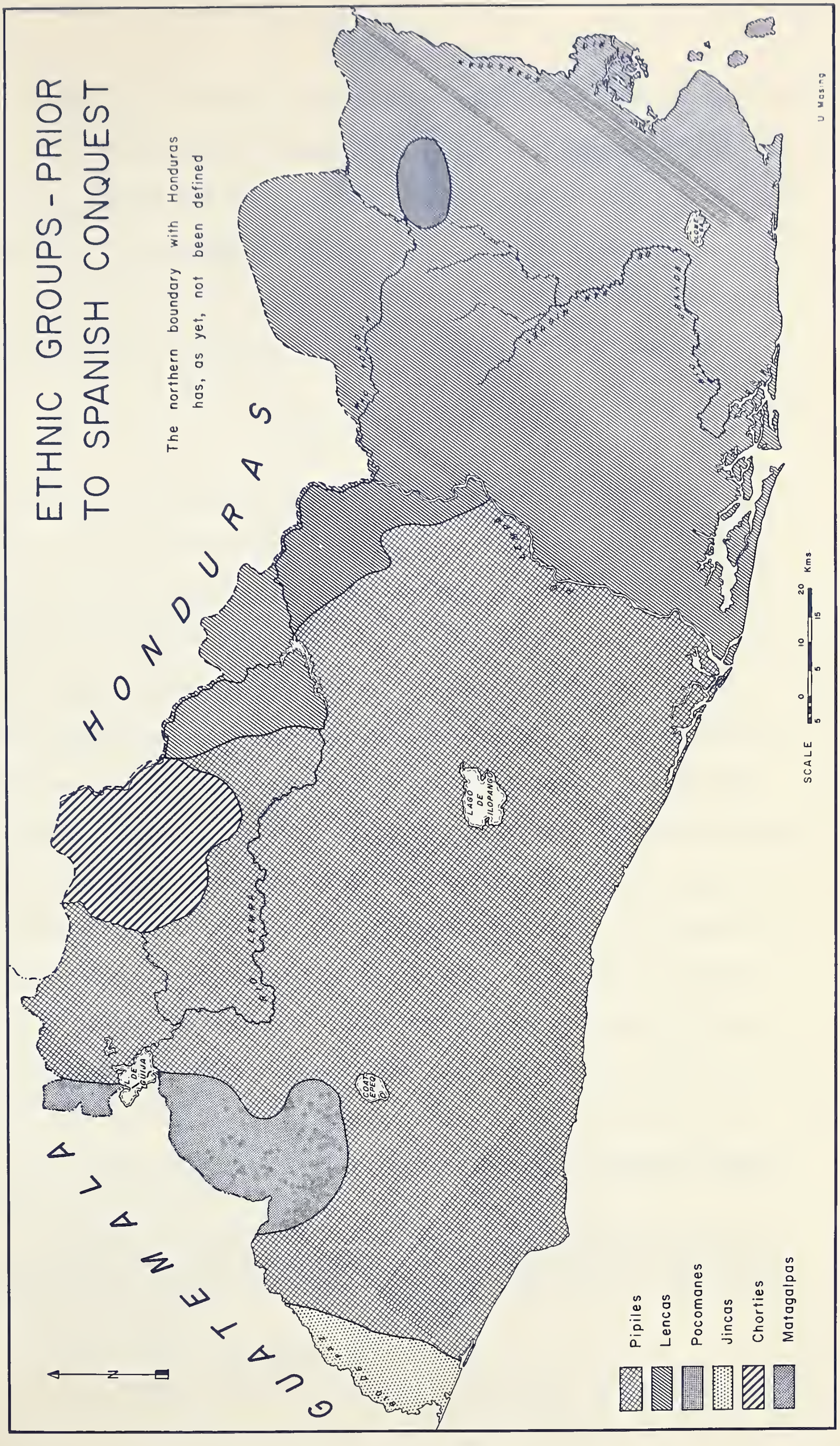
[1] R. Barón Castro, La Población de El Salvador, Madrid, 1942, p. 89.

[2] M. Vidal, Nociones de Historia de Centro America, San Salvador, 1961, p. 38.


ETHNIC GROUPS - PRIOR TO SPANISH CONQUEST
The northern boundary with Honduras has, as yet, not been defined
HONDURAS
GUATEMALA
LAGO DE ILOPANGO
SCALE
Kms
Pipiles
Lencas
Pocomanes
Jincas
Chorties
Matagalpas
U Masing

MAP VIII

Aside from the Pipil and the Lenca, four smaller groups occupied parts of El Salvador. The Jincas,[3] an independant ethnic and linguistic group, settled the lower part of the Río de Paz.[4] The Pocoman and the Chorti, both descendants of the Maya, had their nuclei in Guatemala. A small group of Matagalpas, belonging to the ethnic groups of Nicaragua, formed an island within the kingdom of Chaparrastique.

Population Growth

From the earliest reports available it would seem that El Salvador was comparatively thinly populated before the coming of the Spaniards. Barón Castro[5] estimates the population of what constitutes present-day El Salvador, at the time of the arrival of Alvarado (1524), to have been somewhere around 130,000. Soon after the conquest the native population declined as a natural consequence of the contact between a more advanced conqueror and a primitive people, reaching its low by 1551, with an estimated population of 60,000. By 1570, the population had again increased to 77,000 and continued to rise rapidly to the present. Within the forty years from 1920 to 1959, the population of El Salvador has increased from 1,168,000 to an estimated 2,564,063 or 119 per cent. According to the United Nations estimates, El Salvador's population, with a yearly increase of approximately three per cent,[6]

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[3] A. Recinos, Pedro de Alvarado, Conquistador de México y Guatemala, México, 1952, p. 87.

[4] During his conquest of Cuzcatlán, Pedro de Alvarado speaks of the 'Sincas', whom he encountered east of the Río de Paz. He refers to them as speaking another language, and being different from the people thus far encountered.

[5] Baron Castro, op. cit., p. 124.

[6] J.S. Duncan, "Reporte Preliminar: Necesidades y Recursos de El

will reach the 3,000,000 mark by 1970. Like most Latin American countries, El Salvador has a high birth rate and there seems to be no reason why this should not continue for some time to come (see Table IX).

TABLE IX—RATES OF BIRTH, DEATH, AND NATURAL INCREASE FOR SOME CENTRAL AMERICAN ENTITIES

COUNTRY	BIRTH RATE 1930/34	BIRTH RATE 1948/52	DEATH RATE 1930/34	DEATH RATE 1948/52	NATURAL INCREASE 1930/34	NATURAL INCREASE 1948/52
Costa Rica	44.6	47.2	22.3	12.3	22.3	34.9
El Salvador	43.3	47.7	23.0	15.7	23.3	31.7
Guatemala	51.1	51.7	26.2	22.3	24.9	29.4
Panama	36.5	33.8	15.4	9.9	21.1	23.9
Br. Honduras	37.4	40.1	23.7	12.4	13.7	27.7

Source: United Nations, Department of Social Affairs, The Population of Central America (Including Mexico), 1950-1980, Population Studies, No. 16, Report 1, New York, 1954, p. 13.

Of the Central American republics, El Salvador is surpassed in birth rate only by Guatemala. Although not the highest, the death rate of El Salvador is still high. The census of 1950[7] indicates an infant mortality of 106.3 per 1,000 people, for children under one year of age.

Population Density and Distribution

With the exception of Haiti, El Salvador is the most densely populated country of the Americas (see Table X). Of the total estimated

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Salvador Relacionados a Differentes Tasas de Crecimiento de Población", Comumicaciones del I.T.I.C., No. 1, San Salvador, 1956, p. 6.

[7] United Nations, Department of Social Affairs, The Population of Central America (Including Mexico), 1950-1980, Population Studies, No. 16, Report 1, New York, 1954, p. 6.

TABLE X--POPULATION DENSITY OF CENTRAL AMERICA

COUNTRY	POPULATION	AREA[a]	DENSITY[b]
El Salvador	2,564,063[d]	21,160[e]	121
Guatemala	3,545,212[d]	108,889	32
Costa Rica	1,134,626[c]	51,011	22
Honduras	1,828,183[c]	112,088	16
Panama	1,000,000[d]	74,010[f]	14
Nicaragua	1,423,511[c]	148,000	9
Br. Honduras	88,156[d]	22,699	4

[a] Area given in sq. kms..
[b] Density given in sq. kms..
[c] 1958 estimate.
[d] 1959 estimate.
[e] See Appendix A for detailed information.
[f] Panama: Population and area for the Republic only -- does not include the Canal Zone.

Source: F.H. Sternberg, Statesmen's Yearbook, London, 1960, no pp..

population of 2,564,063 for 1959, 1,612,711 or 60 per cent, are classed as rural and only 944,386 are classed as urban[8] (see Table XI). Compared to the country as a whole, the percentage of the rural population for eastern El Salvador is, with 73.6 per cent, considerably higher than the rest of the Republic.

The census figures, however, do not reflect the true degree to which the people of El Salvador live in a rural environment and derive their livelihood from the pursuit of agriculture. It is my opinion that almost without exception, the 24 per cent of the people who live in centers of less than 2,000 people, should not be classed as urban. These centers are, in fact, nothing but rural agglomerations and fail

[8] El Salvador, Ministerio de Economia, Boletin Estadistico, No. 47, San Salvador, 1960, p. 145.

TABLE XI--DISTRIBUTION OF THE URBAN POPULATION

CENTERS OF POPULATION	PERCENTAGE OF POPULATION
Less than 500	2.7
500 - 1,000	9.0
1,000 - 2,000	12.8
2,000 - 5,000	16.1
2,000 and more	59.4

Source: El Salvador, Ministerio de Economía, Atlas Censal de El Salvador, San Salvador, 1955, p. 34.

to provide any of the essential services characteristic of urban settlements.[9] This means that extremely small centers have been placed in the urban category, and their population included in the urban total. To a degree the same is true of some centers with populations of 2,000 and more. If the 24 per cent of the population at present classed as urban were to be classed as rural, the total rural population of the Republic would be in the vicinity of 72 per cent, which is closer to the truth.

Politically, El Salvador is divided into three zones and fourteen departamentos (see Map IX). These are further divided into municipios of which there are a total of 260 within the Republic. The number of municipios always coincides with the number of cities, towns, and villages within each department. Thus, the nucleus of each municipio becomes an "urban" center, regardless of its characteristics and functions.

On the basis of the population estimates for 1959, I have drawn the accompanying population map (see Map X). After calculating the density of population per sq. km. of each municipio, I grouped all

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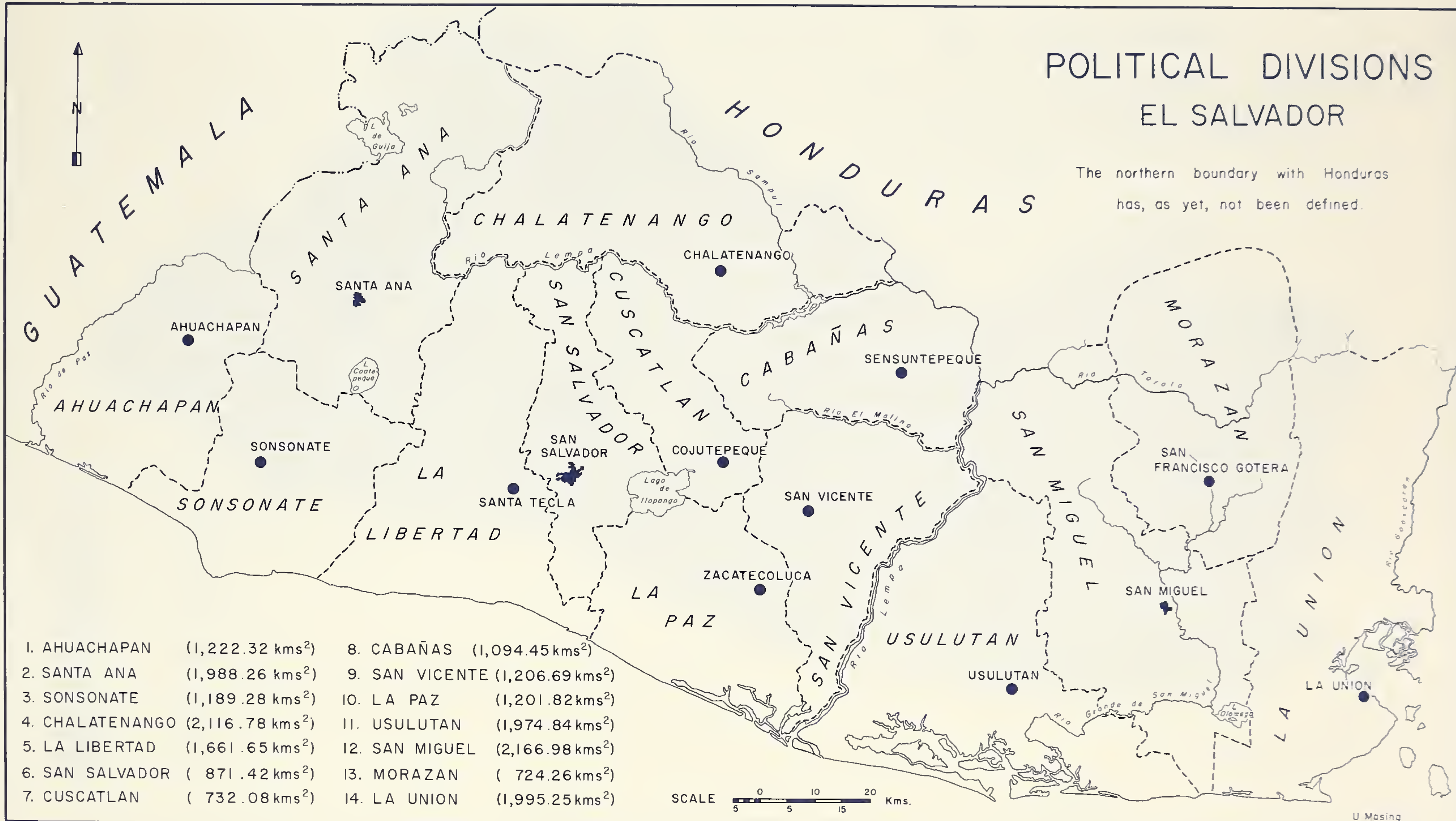
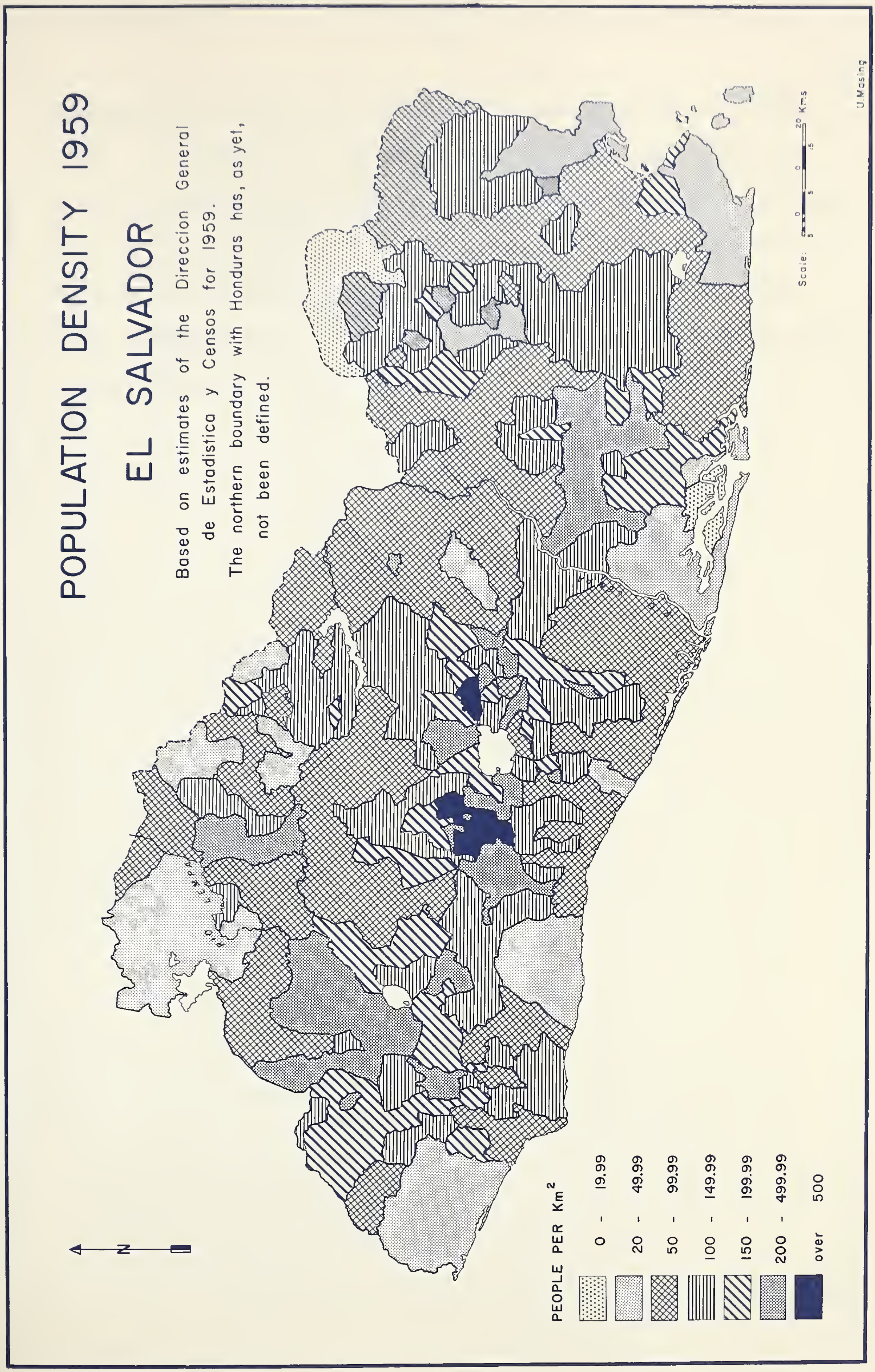
[9] For a more detailed discussion see Part II, Chapter 5.

[illegible]


POLITICAL DIVISIONS
EL SALVADOR
The northern boundary with Honduras has, as yet, not been defined.
N
GUATEMALA
HONDURAS
AHUACHAPAN
SANTA ANA
SONSONATE
CHALATENANGO
LA LIBERTAD
SAN SALVADOR
CUSCATLAN
CABAÑAS
SAN VICENTE
LA PAZ
USULUTAN
SAN MIGUEL
MORAZAN
LA UNION
SANTA TECLA
COJUTEPEQUE
SENSUNTEPEQUE
ZACATECOLUCA
SAN FRANCISCO GOTERA
L. de Guija
L. Coatepeque
Lago de Ilopango
L. Olomega
Rio de Paz
Rio Sampul
Rio Lempa
Rio El Molino
Rio Torola
Rio Goascoran
Rio Grande de San Miguel
1. AHUACHAPAN (1,222.32 kms²)
2. SANTA ANA (1,988.26 kms²)
3. SONSONATE (1,189.28 kms²)
4. CHALATENANGO (2,116.78 kms²)
5. LA LIBERTAD (1,661.65 kms²)
6. SAN SALVADOR (871.42 kms²)
7. CUSCATLAN (732.08 kms²)
8. CABAÑAS (1,094.45 kms²)
9. SAN VICENTE (1,206.69 kms²)
10. LA PAZ (1,201.82 kms²)
11. USULUTAN (1,974.84 kms²)
12. SAN MIGUEL (2,166.98 kms²)
13. MORAZAN (724.26 kms²)
14. LA UNION (1,995.25 kms²)
SCALE 5 0 5 10 15 20 Kms.
U Masing

MAP IX


POPULATION DENSITY 1959
EL SALVADOR
Based on estimates of the Direccion General de Estadistica y Censos for 1959.
The northern boundary with Honduras has, as yet, not been defined.
N
PEOPLE PER Km²
0 - 19.99
20 - 49.99
50 - 99.99
100 - 149.99
150 - 199.99
200 - 499.99
over 500
Scale:
U.Masing

MAP X

municipios with equal densities to show a general pattern of distribution. From the map it is evident that the bulk of the people, or the highest densities are closely associated with the central uplands.

The population is racially and culturally homogeneous. Over 90 per cent are classed as _mestizo_, that is, of mixed white and Indian blood. _Mestizos_ have a literacy rate of 57 per cent for the age group from ten years upwards.

CHAPTER III

AGRICULTURAL DEVELOPMENT

El Salvador, like most Latin American republics, is an agricultural country. What makes it different from most is the fact that few others depend on one agricultural commodity for a livelihood to the same degree, as tiny El Salvador. The Republic's economy is closely geared to agricultural production and particularly to the production of coffee. Most of its people are either working directly in agriculture or in industries that depend on agricultural products. A large percentage of the people are rural although this fact is obscured by the official population distribution figures as indicated in the previous chapter. With a rapidly expanding population and higher demands for food, the country is striving to increase agricultural output through higher yields, more efficient means of production and the use of improved types of crops.

Pre-Colonial Agriculture

Prior to the coming of the Spaniards to the New World, native agriculture had reached a point of stagnation. The Indians, lacking such basic implements as the plow and iron tools to cultivate the land, used the milpa system of agriculture,[1] which is characterized by the

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[1] O.F. Cook, Milpa Agriculture - A Primitive Tropical System,

planting of crops in temporary clearings. After the forest is cleared the land is burned towards the end of the dry season, to clear it from debris and prepare it for the planting of maize (Zea mays) and black beans (Phaseolus vulgaris), the staple food. Planting is done with a planting stick or macana soon after the first rains. For the cutting of forest and the cultivation of the land the Indians used the hacha (axe or hatchet) and the azadon (mattock), which were made of copper.[2] After a period of two to three years of continuous use, the decrease in the natural fertility of the soil diminished the quality and the quantity of the crop. The Indians then abandoned those fields to cut new clearings and initiate a new cycle of cutting, burning, and planting.

Practiced from the Pre-Columbian days to the present, the milpa system of agriculture has devastated large areas of the country's natural vegetation, either eliminating it completely or changing it into a secondary growth of brush vegetation. With the introduction of the plow, the level areas were soon taken up by more extensive forms of agriculture; thus the milpa system is found restricted to the hilly parts of the country, inaccessible to plow cultivation, occupying the steeper slopes (see Figure 28), some as steep as 70 per cent and more,[3]

Annual Report of the Board of Regions of the Smithsonian Institution - 1919, Publication 2601, Washington, D.C., 1921, p. 308. The Aztecs of Mexico referred to a field of corn as "milpa", a term which was adopted by the Spaniards, and is commonly applied for this particular type of corn cultivation.

[2] F. de Garcia Pelaez, Memorias para la Historia del Antiguo Reino de Guatemala, 2nd Ed., Guatemala, 1943, Vol. I, p. 36.

[3] W. Vogt, The Population of El Salvador and Its Natural Resources, Washington, D.C., 1946, p. 15.

causing further damage with each cycle of burning, planting, and abandoning of the milpas, and leaving the already poor land more impoverished (see Figures 23 to 25). The result of this is a ceaseless erosion, clogging the rivers and causing floods, spreading sterile sands over fertile valley lands.

Aside from the basic crops of maize and black beans which the Indians supplemented with game and fish, they also cultivated onions, chile, zapote (Zapote mamey), yuca (Manihot utilissima), papaya (Carica papaya), squash (Curcurbita spp.), avocado (Persea spp.), and many others.[4] They were familiar with cotton (Gossypium sp.) cultivation and the weaving of cotton cloth.[5] For the making of rope, hammocks, and fish nets, they used the fiber of the native henequen plant (Agave letonae), which was probably cultivated on a small scale. Two other important plants cultivated in the coastal lowlands and along the southern slopes of the central mountains, before the coming of the Spaniards, were cacao (Theobroma cacao), and balsam (Myroxylon pereirae). The cultivation of cacao held an important place in the native economy, for the cacao bean, aside from being used for the making of chocolate drinks, served as a medium of exchange, taking the place of money. Scherzer,[6] in his travels in 1854, mentions the cacao bean as still being used in some parts of the country as a monetary unit for the purchase of goods that had a lower value than the smallest coin of the Republic. The balsam tree, a leguminous tree native to El Salvador, was tapped by the Indians for its resin, which they used for medicinal purposes.

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[4] García Peláez, op. cit., p. 34.

[5] A. Recinos, Pedro de Alvarado, Conquistador de México y Guatemala, Mexico, 1952, pp. 89-90.

[6] C. Scherzer, Wanderungen, Braunschweig, 1857, p. 459.

Colonial Agriculture

The coming of the Spaniards initiated a new era in agriculture. On their arrival to the New World they encountered an indigenous subsistence agriculture where, under the leadership of tribal chiefs, the land was worked on a sharecrop basis and only the amount necessary to satisfy the primary needs of food and clothing was cultivated, with relatively little being used for inter-tribal trade. There was no organized commerce between different ethnic groups and indigenous empires, and they did not value metal as a medium of exchange.

With the coming of the Spaniards the economy and land use changed. The land began to be worked, not only for the supply of local requirements, but to supply export commodities for the markets of Europe. Agriculture was put on a commercial basis. Of the native plants which the Spaniards encountered, cacao and balsam were the first to attract their attention and assume importance as export products. Balsam, known under the name of Balsam of Peru, was already known in Europe by 1562, as is evident from a Papal Bull issued by Pope Pius IV, in which he declared the destruction of balsam trees to be a sacriligious act because of the use of balsam in the preparation of the chrism.[7]

Of great economic importance during the early Colonial Period was the production of cacao. After the conquest cacao was introduced to European markets and due to its great popularity, cacao plantations spread rapidly throughout the tropical Americas, and from there to Africa and Asia. For a while El Salvador participated in the export to Europe where its cacao was held in great esteem due to its excellent

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[7] Scherzer, op. cit., p. 406.

quality. Vazquez de Espinosa, in his travels in the early seventeenth century,[8] makes reference to cacao groves along the southern slopes of the Cadena Costera, particularly in the Sonsonate coastal plain, where Garcia Pelaez estimated the production of cacao for the year 1576, to have been around 112,500 quintals.[9,10]

However, by the end of the seventeenth century cacao exports dwindled[11] due to lower transportation and production costs elsewhere, particularly in Venezuela and Ecuador. During the seventeenth century trade in cacao did not even amount to one half of the amount exported during the sixteenth century, and in 1730, the Government of Spain issued a trade embargo on cacao.[12] By the end of the Colonial Period cacao had virtually ceased to be an export article.

Today El Salvador does not produce enough cacao to satisfy its own demands. Of the 4,000 quintals needed for internal consumption, the country produces only about 2,500 quintals or 63 per cent. Of these, 2,000 quintals are produced near Sonsonate on the only cacao plantation of importance in the country; the rest is produced by small farmers throughout the country.[13] The deficiency of 37 per cent comes from Guatemala and Nicaragua.

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[8] A. Vazquez de Espinosa, Compendio y Descripcion de las Indias Occidentales, Washington, 1948, p. 209.

[9] F. Choussy, Economia Agricola Salvadoreña, San Salvador, 1950, p. 78.

[10] 1 quintal = 100 pounds (approximate)

[11] Pelaez, op. cit., p. 35.

[12] Loc. cit., "Al paso que aumentaba la poblacion, era restringido el comercio. Empezando por el cacao, el trafico que se hace de este fruto en el siglo 17 no llega a la mitad del que se hacia en

Although the Conquistadores and newcomers cultivated some of these native plants with great success, the real changes came with the introduction of the steel-pointed Egyptian plow and the ox as a draft animal to pull it. The plowing of the land spread throughout the country, making the Colonial Period one of great activity and change in agriculture.

Aside from the plow and draft animal, the Spaniards introduced domesticated livestock and new plants. The most outstanding of these were: the cereals — rice, wheat, oats, and barley — and sugar cane, cattle, horses and mules, etc.. Livestock seems to have done well and was widespread by the end of the sixteenth century. Herrera states that cattle did better than in Spain, and that wheat (trigo) could be harvested twice a year although the second crop was not as good as the first.[14]

Sugar cane found its way into El Salvador via the West Indies, where it was first cultivated in the New World. However, it is mentioned as early as the middle of the sixteenth century in Guatemala. Since no mention is made of exports it could be assumed that the product was probably consumed locally in the form of panela, or aguardiente,[15] an alcoholic beverage common throughout Latin America. According to

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el siglo 16. Si en este excedio su importacion a la Nueva España de million y medio de pesos, en la segunda centuria no se ve mas semejante extraccion. Desparecieron en ella las embarcaciones del pais, y al propio tiempo todo su comercio."

[13] Choussy, op. cit., p. 79.

[14] Quoted by Peláez, op. cit., p. 174.

[15] Peláez, op. cit., Vol. II., p. 228.

Cortez y Larraz[16] sugar cane had become widely distributed throughout El Salvador by 1769 to 1770, particularly in the area between San Salvador and San Vicente (see Map XI).

A plant which was to assume considerable economic importance soon after the conquest, and continued to do so until the end of the nineteenth century, was the native <u>añil</u>, a dye extracted from the leaves of the <u>indigofera</u> plant, also known by the Indian name <u>jiquilite</u>. The pre-Columbian Indians produced a blue dye from this plant, known as the common <u>añil</u> of Central America.[17] Herrera states that indigo was cultivated on a commercial scale in El Salvador as early as 1530, and refers to it as "this bush which colors the waters blue".[18] Vázquez de Espinosa[19] who travelled the country in the early part of the seventeenth century, also makes repeated reference to the numerous dye works (<u>obrages</u>) of <u>añil</u>. Raynal[20] gives the export figures for 1630, as approximately 112,000 lbs. (1,000 <u>centner</u>). The planting of indigo requires little work. The plant will grow on almost any kind of soil with a minimum of care. Before seeding the land is burned and plowed slightly, whereupon the seed is scattered by hand during the end of the dry season.

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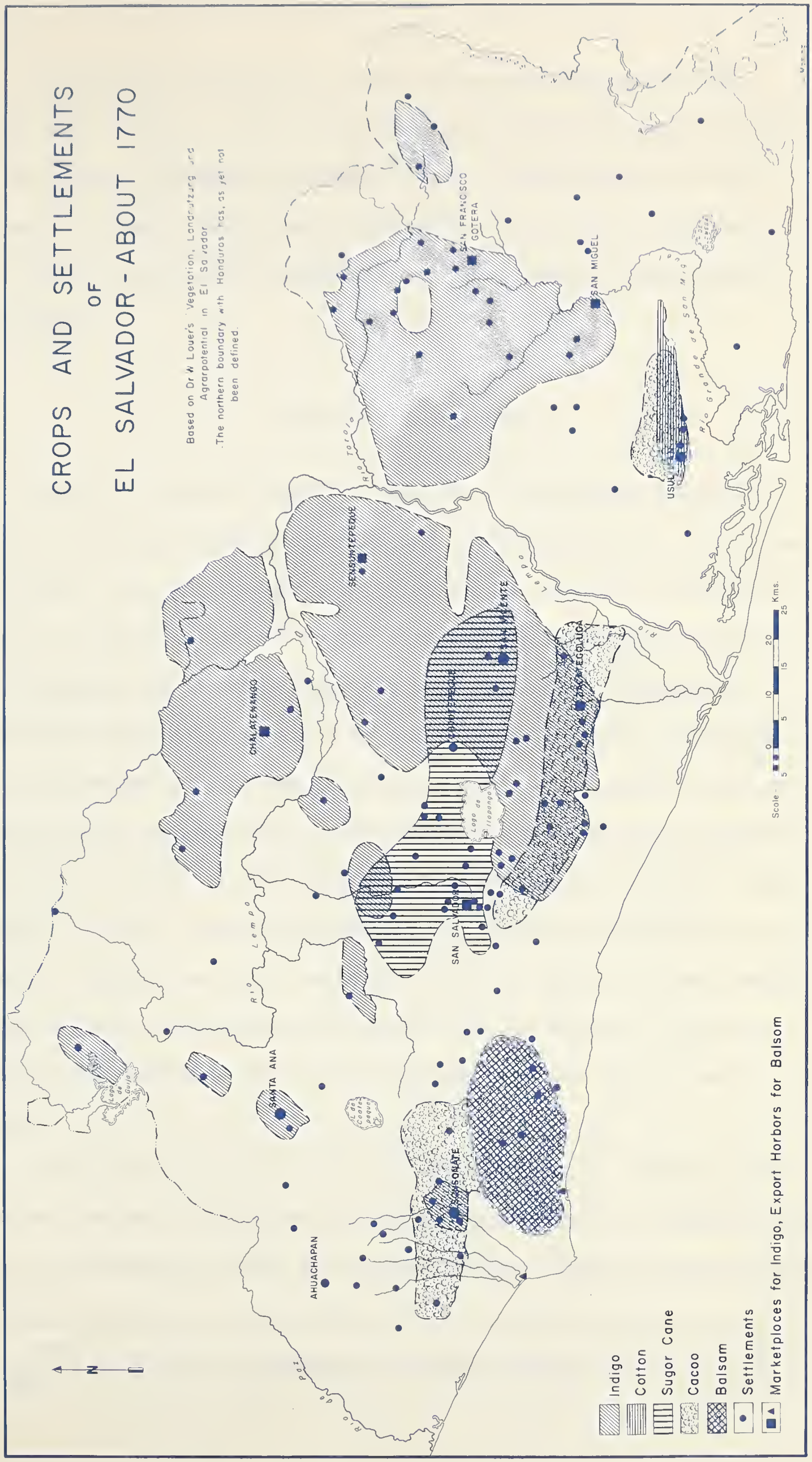
[16] Quoted by Lauer, <u>op. cit.</u>, p. 54.

[17] C. Sauer, "Cultivated Plants of South and Central America", <u>Handbook of South American Indians</u>, Washington, 1950, p. 542. F. Choussy is of the opinion that the Indians used the species <u>Indigofera añil</u>, native to Central America, which was crossed with the imported Asiatic species <u>Indigofera tinctoria</u>, which resulted in numerous subspecies of which there are more than 140 at present. <u>Economia Agricola Salvadoreña</u>, p. 477.

[18] Quoted by Scherzer, <u>op. cit.</u>, p. 403.

[19] Vázquez de Espinosa, <u>op. cit.</u>, p. 215.

[20] Quoted by Scherzer, <u>op. cit.</u>, p. 403.


CROPS AND SETTLEMENTS OF EL SALVADOR - ABOUT 1770
Based on Dr W. Lauer's 'Vegetation, Landnutzung und Agrarpotential in El Salvador'
The northern boundary with Honduras has, as yet, not been defined.
Indigo
Cotton
Sugar Cane
Cacao
Balsam
Settlements
Marketplaces for Indigo, Export Harbors for Balsam
Scale - Kms.
5 0 5 10 15 20 25
N
SAN FRANCISCO GOTERA
SAN MIGUEL
USULUTAN
Rio Grande de San Miguel
Rio Torola
SENSUNTEPEQUE
SAN VICENTE
ZACATECOLUCA
COJUTEPEQUE
Lago de Ilopango
CHALATENANGO
SAN SALVADOR
Rio Lempa
SANTA ANA
Lago de Guija
L. de Coatepeque
SONSONATE
AHUACHAPAN
Rio Paz

MAP XI

Following the decline of cacao during the early part of the seventeenth century, indigo held first place among the export products of the country throughout the latter part of the Colonial Period. Squier[21] estimated yearly production at the close of the Colonial Period to have been around 1,800,000 lbs. or more, with a value close to $3,000,000.

Period of Independence

Cut off from the motherland, the newly independent (1839) Republic had to find means to provide the currency necessary to finance its imports. During the early Colonial period cacao had provided the means to balance payments. By the sixteenth century indigo came into the foreground as the most important product. After independence only balsam and indigo remained as chief export products. To create new revenues and to overcome the chronic labor shortage that had hampered colonial agriculture, the new governments encouraged immigration and private capital by providing better opportunities to obtain land through favorable laws and guarantees. As a result, cultivation increased rapidly. New crops were introduced for export and new methods in agriculture and transportation opened up the country to the production of commodities which would compete favorably on the world market.

During the early part of the nineteenth century, indigo production had reached its peak and was declining gradually as synthetic dyes left an ever smaller market for vegetable dyes. Added to the decline of

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[21] E.G. Squier, The States of Central America, New York, 1858, p. 288.

indigo production were the continuous political upheavals that have haunted the country from its first days of independence. Indigo has to be harvested promptly at the proper period, requiring a large and reliable labor force during the harvest season. Political unrest induced many of the workers to hide in order to avoid conscription, resulting in the decline of the indigo production.[22]

Despite all the disadvantages, indigo continued to be the largest single export product and producer of national income until 1865. Squier gives the income from indigo exports for 1855 and 1857, as $660,520 and $1,107,610 respectively, or approximately 85 per cent of the total exports[23] (see Table XII).

TABLE XII--EXPORTS FOR EL SALVADOR FOR THE YEARS 1855 AND 1857

	QUANTITY		VALUE IN DOLLARS	
ARTICLES	1855	1857	1855	1857
Indigo (bales at 150 lbs. each)	4,718	7,450	660,520	1,107,610
Tobacco (do.)	2,129	1,813	25,478	18,815
Balsam (lbs.)	22,804	7,890	19,827	6,904
Hides (number)	24,255	27,824	27,347	61,186
Sugar (lbs.)	--	865,651	--	52,100
Cedar Planks (ft.)	25,515	--	1,148	--
Silver (ozs.)	8,416	8,416	3,112	3,112
Ore (bags)	26	--	2,240	--
Sundries	--	--	20,348	54,371
TOTAL			$765,324	$1,304,102

Source: E.G. Squier, The States of Central America, New York, 1858, p. 290.

In 1865, cotton appeared for the first time as an export product, replacing indigo. Cotton, which was cultivated in pre-Colonial days,

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[22] Squier, *op. cit.*, p. 290. [23] *Ibid.*, p. 290.

continued to be grown on a small scale throughout the Colonial Period (see Map X). As a result of the Civil War in the United States, the demand for cotton on the world market induced larger-scale cultivation and exports in El Salvador. In 1865, cotton export had reached its peak, representing 24 per cent of the total exports of the country.[24] At the same time coffee exports amounted to only 4.85 per cent of the total national export. By 1870, the demand for cotton on the world market had stabilized and cotton completely disappeared from the list of exports in El Salvador. With rising demands and prices after World War I, an attempt was made to revive cotton production. In 1923, more than 30,000 manzanas[25] (approximately 20,000 has.) were planted to cotton, but lacking proper pest control, almost all of the cultivated areas were destroyed by pests (gusano medidor) within a fortnight. As a result cotton again disappeared as an export article. Choussy[26] gives the cultivated area for the period of 1923 to 1930, as 1,000 to 1,500 manzanas (750 to 1,000 has.).

Another commodity of long-standing which assumed some importance during the middle of the last century was sugar cane. Cultivated throughout the tropical parts of Central America, sugar cane had come to El Salvador via Cuba and Guatemala during the early days of the Colonial Period. Squier[27] gives the increase in settlements in California as the reason for the increased demand in sugar exports. In 1857, sugar stood in third place as an export commodity. Squier noted

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[24] Choussy, op. cit., p. 271.

[25] 1 hectare = 1.43 manzanas.

[26] Choussy, op. cit., p. 275.

[27] Squier, op. cit., p. 311.

that sugar was widely produced from small _trapiches_ (primitive sugar mills) scattered throughout the country. During the Colonial Period, sugar production was mainly in the hands of small farmers who cultivated it in their _huertas_ (gardens). Large sugar plantations are of fairly recent origin and have been introduced only within the last few decades.[28]

Of fundamental importance to the economy of the country was the introduction of coffee in 1840. The first plantations were on the slopes of the Volcán Santa Ana, whence the cultivation spread throughout the department and into the neighboring departments of La Paz and San Salvador. In 1859, coffee made its appearance as an export commodity, accounting for approximately one per cent of the total exports of the country. By 1865, coffee had assumed 4.85 per cent of the nation's exports and was increasing rapidly in importance (see Table XIII).

From 1879 on, coffee became the largest single export of the nation representing as much as 98 per cent of the total national export during peak periods. Table XIII clearly demonstrates that all efforts were directed towards a rapid increase in the production of coffee. In 1879, coffee had passed the leading export products, cotton and indigo.

Associated with commercialized coffee culture was the production of _henequen_ (_Agave letonae_), the fibre of which is used for the production of coffee bags. Known to the pre-Columbian Indians, _henequen_ was first introduced on a commercial basis between the years 1885 and 1890, by General Letona who, on his return to San Miguel from a trip

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[28] Lauer, _op. cit._, p. 63.

to Yucatan, discovered that the native henequen plant resembled that of Yucatan where it was produced commercially on large plantations.[29]

TABLE XIII--INCREASE OF COFFEE AS AN EXPORT ARTICLE FROM 1865 TO 1879

YEAR	PERCENTAGE OF TOTAL EXPORTS
1865	4.85
1866	8.09
1867	9.50
1868	15.32
1869	13.47
1870	17.04
1871	17.34
1872	12.60
1873	30.30
1877	42.66
1879	48.50

Source: F. Choussy, Economía Agrícola Salvadoreña, San Salvador, 1950, p. 380.

Present Agricultural Conditions

Despite increased industrialization during the last decade agriculture has continued as the most important element in the economy of the country. Of a total labor force of 653,409 in 1950, 412,646 or 63.2 per cent were directly employed in agriculture, and 231,710 were employed as seasonal workers on coffee fincas and cotton farms throughout the country.[30] Agricultural products account for 85 to 90 per cent of the nation's exports and provide, with the exception of the tourist dollar, all of the Republic's foreign exchange.

The most fundamental problem of El Salvador is the fact that the

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29 Choussy, op. cit., p. 302.

30 Ibid., p. 422.

country is deficient in the production of food. Population density is already high and growing rapidly. An analysis of the land resources shows the following distribution:[31]

TABLE XIV—DISTRIBUTION OF LAND RESOURCES IN EL SALVADOR IN 1950

TYPE OF LAND USE	HECTARES	PERCENTAGE
Land under cultivation - Arable: Annual crops of corn, beans, rice, cotton, etc..	297,162	14.0
Land under cultivation - Not Arable: Permanent crops of coffee, fruits, henequen, and cultivated pasture.	268,469	12.6
Forests and marshlands:	26,882	1.3
Other agricultural lands: *Milpa* lands, unimproved pastures, land not cultivated but available for use.	1,053,810	50.0
Land not cultivable: Waste lands, lakes, rivers, estuaries, settlements, etc..	469,677	22.1
TOTAL:	2,116,000	100.0

Sources: El Salvador, Ministerio de Economía, *Atlas Censal*, San Salvador, 1952, p. 45.; and El Salvador, Ministerio de Agricultura y Ganadería, *Panorama General de la Producción, Distribucion y Consumo de los Principales Renglones Agropecuarios*, San Salvador, 1957, p. 2.

In 1950, approximately 44 per cent of the gross national product was derived directly from agriculture (see Table XV), of which coffee contributed 43 per cent, miscellaneous agricultural products three per cent, and 22 per cent were contributed by basic food crops. The total value was calculated at 177,000,000 *colones*[32] ($70,800,000),

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[31] See Appendix B.

[32] ₡2.50 = U.S. $1.00.

or 88 colones per capita, which was considered an insufficient amount to adequately feed the population of the country. With a population density of 121 per sq. km., and an estimated annual growth at the rate of three per cent, the country will have to increase the output of basic foods at a substantial rate or increase the present amount of food imports.

TABLE XV—NATIONAL PRODUCT DERIVED FROM COFFEE

(in thousands of dollars)

YEAR	VALUE	PERCENTAGE OF TOTAL
1950	$146,680	43.35
1953	136,207	37.68
1955	158,986	37.70
1957	176,339	36.20

Source: U.S. Dept. of Commerce, World Trade Information Service, Part I, Nos. 56-59, Washington, D.C., 1959, p. 4.

It has been estimated that approximately 10 per cent, or 150,000 has. of the "other lands" (see Table XIV) could be claimed as arable land and be put under cultivation with improved transportation facilities and adequate drainage. Much of this land has already gone into production since the opening of the new littoral highway.

Export Crops

Coffee

El Salvador is a country with an economy based on a single product — coffee — and is the third largest coffee exporter of the Americas, surpassed only by Brazil and Colombia. Coffee is the

lifeblood of the nation, and rules the social life as well as the economy of the Republic. A slight drop in coffee prices on the world market can destroy the thin wall which separates prosperity from depression. Coffee provides about 83 per cent of the nation's foreign exchange. This is a slight reduction over the past years due to an increased cotton production, for coffee has at times represented as much as 90 per cent of the nation's exports (see Table XVI).

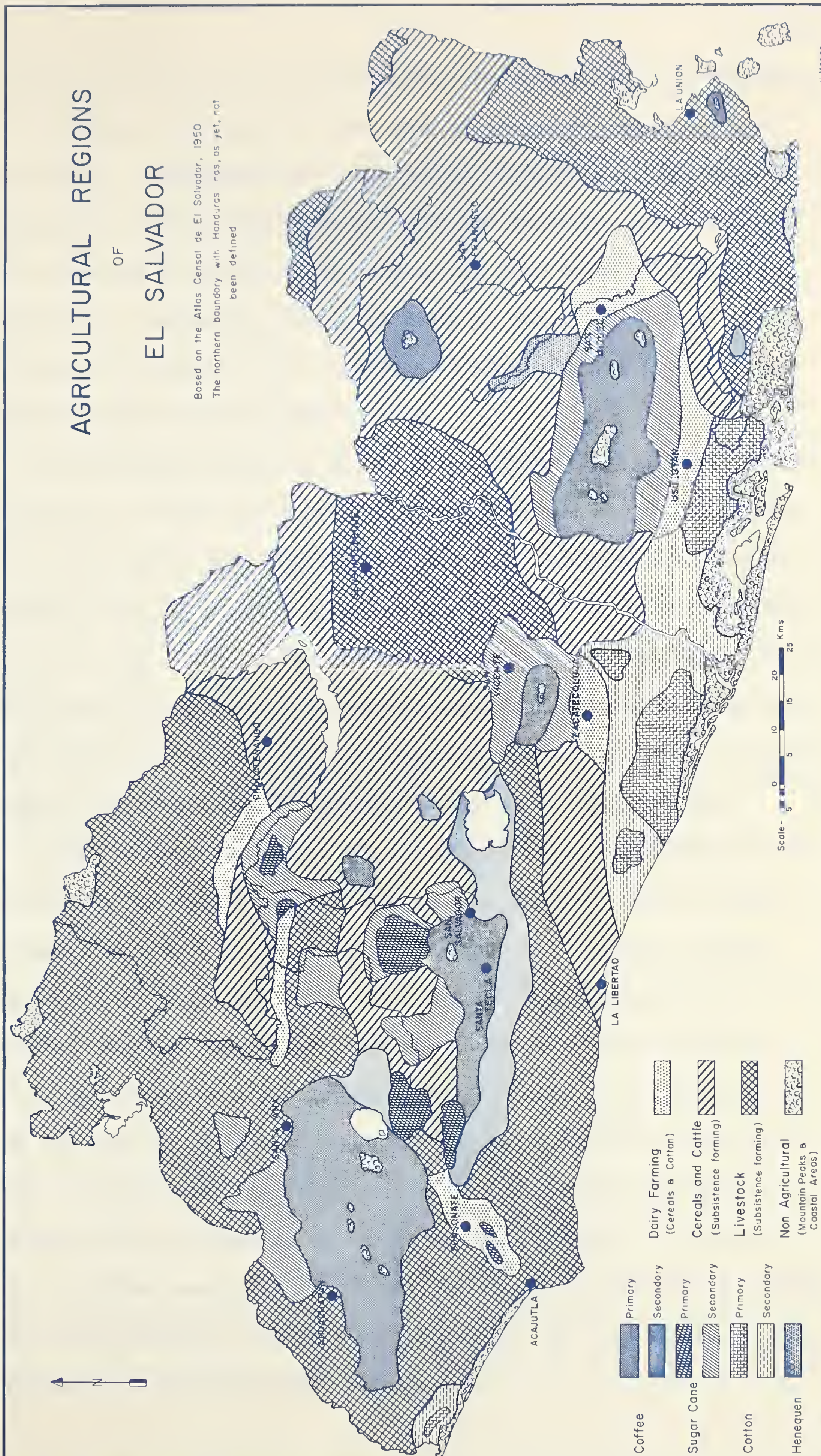
TABLE XVI--INCREASE IN COFFEE AREA AND PRODUCTION FROM 1950/51 TO 1959/60

(production in quintals)

YEAR	HECTARES	PRODUCTION
1950/51	115,429	1,632,082
1951/52	-	1,654,690
1952/53	-	1,632,534
1953/54	-	1,552,382
1954/55	-	1,760,901
1955/56	115,424	1,888,571
1956/57	-	2,076,000
1957/58	120,140	1,891,100
1958/59	-	1,832,600
1959/60	-	2,050,200

Sources: El Salvador, Ministerio de Economia, Boletin Estadistico, No. 47, San Salvador, 1960, p. 194; and El Salvador, Ministerio de Agricultura y Ganaderia, Panorama General de la Produccion, Distribucion y Consumo de los Principales Renglones Agropecuarios, San Salvador, 1957, pp. 4-5.

In 1957/58, coffee occupied an estimated 20 per cent of the total land under cultivation (see Map XII), or approximately 120,140 has. (171,800 manzanas), which is a slight increase of 4,711 has. (6,736 manzanas) over 1950, when 115,429 has. (165,063 manzanas) were under cultivation. Although coffee is grown throughout the Republic,


AGRICULTURAL REGIONS
OF
EL SALVADOR
Based on the Atlas Censal de El Salvador, 1950
The northern boundary with Honduras has, as yet, not been defined
Coffee
Primary
Secondary
Sugar Cane
Primary
Secondary
Cotton
Primary
Secondary
Henequen
Dairy Farming
(Cereals & Cotton)
Cereals and Cattle
(Subsistence farming)
Livestock
(Subsistence farming)
Non Agricultural
(Mountain Peaks & Coastal Areas)
Scale - 5 0 5 10 15 20 25 Kms
N
LA UNION
SAN FRANCISCO
USULUTAN
SAN VICENTE
ZACATECOLUCA
CHALATENANGO
SANTA ANA
SAN SALVADOR
SANTA TECLA
LA LIBERTAD
SONSONATE
ACAJUTLA

MAP XII

more than half of the crop is produced in the departments of Santa Ana and La Libertad, and only 22.16 per cent of the crop comes from the Zona Oriental. At present the total yearly production varies from approximately 1,800,000 quintals to 2,000,000 quintals (see Table XVI) due to alternate two-year cycles of good and poor years of production. Table XVI also indicates a steady increase in the production of coffee over the last ten years. This increase is mainly the result of better techniques rather than increase in area.

In El Salvador coffee is grown at elevations ranging from 350 ms. to 1,600 ms. (1,000 ft. to 5,000 ft.). However, the best coffee grows on the slopes of the volcanic mountains between the altitudes ranging from 2,500 ft. to 4,500 ft., on slightly acid soils of volcanic origin, with a pH of six. Most of the coffee grown is under shade to protect the coffee trees from the strong insolation and evapo-transpiration during the dry period. Many of the shade trees are part of the former natural vegetation cover that has been left standing in the plantations.

Coffee is harvested from late October to March, depending on the elevation and the distribution of the rains. Maximum crops of coffee are closely dependent on the regularity of the rainy season. Heavy rains during the rainy season as well as a prolonged rainy season will damage the blossoms before the young fruit is set, and may cause rotting of the berries from earlier blossoms, and prevent uniform maturing of the crop on individual trees, making harvesting very expensive. Coffee is hand-picked, since there is as yet no machine that will do the work as well and with as little damage to the trees. A further increase in coffee production will result mainly through increased yields and not from increased acreage since almost all the land suited to coffee production is already under cultivation.

Cotton

Prior to 1936, cotton production had received little attention due to cheap imports and repeated crop failures caused by the boll weevil (Anthonumus grandis) and other pests discouraging large-scale production. To encourage production, the Government raised import duties for cotton in 1936; as a result production increased rapidly. By 1940, El Salvador produced 5,000,000 lbs., and in 1941, had a surplus of 3,000,000 lbs.. This made it necessary for the Government to assume control of production, purchase, and sale of all cotton in 1942. The Cooperativa Algodonera Salvadoreña was founded and licensed by the Government to control the production of cotton by the issuing of licenses to growers who must be members of the cooperative. The Cooperative is also the sole agent for the handling of all exports and domestic sales.

Although cotton is grown throughout the country, the Zona Oriental produces 62 per cent of the crop, particularly the departments of Usulután and ~~San~~ Miguel. Since 1942, the total yearly production has increased steadily (see Table XVII) and reached a maximum of 862,793 quintals in 1958/59. At present cotton exports produce 16 per cent of the foreign exchange. Together, cotton and coffee provide approximately 99 per cent of the total national income from exports.

As a result of favorable world prices and modernized agricultural methods including efficient pest controls, production has increased greatly in terms of area cultivated and output per hectare over the past twenty years (see Table XVII). In 1940, approximately 9,769 hectares (13,969 manzanas) were being cultivated with an output of 457 lbs. per hectare, producing a total of 44,644 quintals. By 1960, the area

had increased almost six times, to 56,634 has. (80,986 manzanas), representing about 10 per cent of the total land under cultivation, with an output of approximately 1,800 lbs. per hectare and a total estimated production of over 950,000 quintals. The cotton produced is Delta Plain - 15, a United States upland variety with a staple length of 1 1/32 in. to 1 1/16 in., which is well accepted as an export product on the world market.

TABLE XVII—INCREASE IN COTTON AREA, PRODUCTION, CONSUMPTION, AND EXPORTS FROM 1940/41 TO 1960/61

(production, consumption, and exports in thousands of quintals)

YEAR	HECTARES	POUNDS PER HECTARE	TOTAL PRODUCTION	CONSUMPTION	EXPORTS
1940/41	9,769	457	45	23	18
1947/48	15,588	653	102	49	52
1954/55	29,563	1,510	445	43	403
1956/57	38,369	1,840	704	68	636
1957/58	39,926	1,966	783	63	732
1958/59	53,580	1,731	863	66	796
1959/60	38,912	-	675	113	562
1960/61	56,634	1,800*	950*	-	-

* Estimate (data not available)

Source: Table compiled from several publications by two Salvadoran Government offices: Ministerio de Economía, and Direccíon de Economía Agrícola y Previsión de Cosechas.

Based on 1958/59 figures, internal consumption amounted to roughly eight per cent of the total production, increasing to 20 per cent in 1959/60. This increase was due in part to a decline in prices on the world market, the addition of new cotton mills, and a decrease in imports of textiles from abroad. With increased production prices and falling prices on the world market, there is little likelihood that cotton production will continue to increase very much in the near

future. In 1953, the average production cost per quintal was $17.18, as compared to $23.20 per quintal in 1958. It has been estimated that 70,000 hectars might be the limit of available land for cotton production, without affecting the production of basic food crops. If, however, production should prove profitable, additional areas could be made available.

With the rapidly expanding production of cotton has come an increase in cotton seed supply. All of the cotton seed is processed in the country. Cotton seed meal, oil, and lint are exported after the internal demand has been satisfied. The increasing quantity of available cotton seed has reduced the commercial production of expensive sesame seed to a minor position. Cotton seed meal contributes greatly toward a better balance of food for livestock. Particularly important to the development of a permanent national dairy industry, cotton seed meal as a source of concentrated protein is an important item in milk production.

Of all the agricultural products, cotton has been highly significant in the diversification of agriculture in El Salvador and in providing additional industries such as cotton mills and oil processing plants for the country.

Henequen

Until the early 1930's, *henequen* was a traditional export of El Salvador. Today *henequen* fibers are used in the production of bags for the shipment of coffee, and with increased demands has ceased to be an export product. Most of the *henequen* is produced in the departments of San Miguel and Morazán. In 1949, there were 2,094 *henequeneros*

(henequen producers) cultivating an estimated 5,705 manzanas. Of these nine henequeneros, eight in the department of San Miguel and one in La Union, own and operate 83 per cent of the total area under cultivation as compared to the 2,085 henequeneros who, distributed throughout the country, share between them only 17 per cent of the area with an average ratio of one-half a manzana to each.

Production has remained fairly stable during the last few years and is expected to remain so for some time as the demands do not indicate an increase in the near future. There are at present six beneficios, or plants, where the fibers are processed, all of which are located in eastern El Salvador.

Sugar

The production of sugar is of great economic importance, more in terms of internal consumption than as an export product, although some sugar is exported to the neighboring countries of Guatemala, Honduras, Nicaragua, and to the United States since the trade embargo against Cuba.

Sugar cane is cultivated extensively throughout the country in units ranging from small one-family plots, to large plantations (ingenios). There are at present twenty-one ingenios in the country. The principal areas of production are in the departments of San Salvador, La Libertad and Sonsonate (see Map X), with important regions around San Vicente and San Miguel. The twenty-one ingenios produce a semi-refined sugar, of which approximately 85 per cent is white sugar, and 15 per cent is brown sugar. The area under cultivation has changed little over the past decade but production yields have increased

due to better methods and use of fertilizers (see Table XVIII). The Government controls the production of semi-refined sugar by issuing production quotas to the ingenios and controlling the prices and exports.

TABLE XVIII--AREA AND PRODUCTION OF SEMI-REFINED SUGAR AND PANELA 1950/51 TO 1959/60

(Area in thousands of hectars; Production in thousands of quintals.)

YEAR	SEMI-REFINED AREA	SEMI-REFINED PRODUCTION	PANELA AREA	PANELA PRODUCTION
1950/51	7.1	573	-	-
1951/52	6.0	591	5.3	407
1952/53	6.6	672	6.3	474
1953/54	7.1	658	7.4	461
1954/55	6.4	754	7.3	538
1955/56	6.1	776	6.4	500
1956/57	6.8	995	6.9	585
1957/58	7.6	922	-	-
1958/59	-	-	-	-
1959/60	7.4	1,036	-	-

- No information available.

Source: El Salvador, Ministerio de Economía, Anuario Estadístico - 1958, San Salvador, 1961, Vol. I, p. 255.

Another type of sugar known as panela is produced by small farmers as a family industry, and some is also exported. Under extremely primitive conditions sugar cane is semi-processed and molded into brown cakes from which the molasses have not been removed. There are roughly three thousand trapiches, or primitive sugar mills,[33] many of them still made of wood and driven by oxen that are producing panela and a third type of sugar, pilon, a granulated sugar from which some of the molasses have been removed.

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[33] For a detailed description, see Chapter 5, page 169.

Both the small farmers and the large plantations produce about the same amount of sugar on the same extent of land. During recent years semi-refined sugar has become more widely used due to higher wages and more employment, but the greater part of the sugar consumed internally is still panela.

Basic Food Crops

Although modern plantation agriculture has taken over large parts of the country (see Map X), the basic food crops occupy by far the largest area and give the agricultural landscape its character. Corn together with maicillo, take in a larger cultivated area than any of the commercial crops. Other important food crops are beans, rice, and sugar cane. Corn and beans constitute the bulk of the daily caloric intake of the population.

Normally there has never been a significant shortage of these basic food crops, because generally speaking, the production has been sufficient to meet a below-normal nutritional food consumption of the population. However, with a rapid increase in population, demands will increase for these basic food crops. Thus the problem in the future will be twofold: one, to increase nutritional requirements for the present level of population, and two, at the same time to increase production sufficiently to take care of the increasing needs of a growing population.

Corn

Corn holds the place among the basic food crops comparable to coffee among the export products. Although under normal conditions

there have never been shortages in corn production that were of long duration or that could be called catastrophic, prolonged rains and prolonged droughts together with the locust, have occasionally produced short crises. In recent years, particularly since 1955/56, there has been a slow decrease in the extent of land used for the production of corn due to the enormous increase of cotton production. Much of the land taken over by cotton growers was formerly used for corn production (see Table XIX). The data for the years 1955/56 to 1958/59 clearly indicate a reduction in area for corn. If the production of cotton continues to increase it would seem that land under corn will not increase appreciably until the area in cotton has reached its physical limit. This could have become a serious problem, but the reduction in area has been offset increasingly through the introduction of hybrid corn with a fourfold increase in production. The average yield per hectare for hybrid corn is between 60 and 65 quintals as compared with the average of 15 to 17 quintals of the common native corn. This process of increasing the extent of land in hybrid corn can continue for the next few years until all suitable land for hybrid corn is eventually used for that production. In the meantime, El Salvador has had to import up to 1,100,000 quintals a year, to compensate for the shortages in production.

Corn is planted three times during the year. The first planting is in May - June, and is the largest in terms of area and yield. The second planting is in August - September during the second part of the rainy season and yields a comparatively small return. The third planting occurs in January during the dry season, and is very small and almost insignificant in both area and yield.

TABLE XIX--AREA AND PRODUCTION OF CORN FROM 1950/51 TO 1960/61

YEAR	AREA (Hectares)	PRODUCTION NATIVE CORN	HYBRID	TOTAL
1950/51	152	-	-	3,387
1951/52	158	-	-	3,881
1952/53	182	-	-	3,770
1953/54	183	-	-	3,475
1954/55	190	-	-	3,704
1955/56	172	-	-	3,137
1956/57	167	-	-	3,454
1957/58	156	2,629	600	3,229
1958/59	178	-	-	3,077
1959/60	178	2,661	612	3,273
1960/61[a]	152	1,612	981	2,593

[a] Data for first planting only.

- No data available.

Source: El Salvador, Ministerio de Economía, Boletín Estadístico, No. 47, San Salvador, 1960; and Ministerio de Agricultura y Ganadería, Informaciónes, No. 78, San Salvador, 1959.

Beans

Next to corn, beans are the most important basic food item. They are also grown throughout the country, and are planted three times during the year, at the same time the corn is planted. Production has decreased by about 75 per cent during the last decade (see Table XX), particularly from 1956 to 1960, partly due to crop failure caused by unfavorable climatic conditions but mostly due to the change from corn to cotton, inasmuch as beans are produced in inter-cultivation with corn. El Salvador is basically self-sufficient in this commodity, although small amounts are imported in some years if production is low due to poor harvest. The additional land needed for the production of beans is, however, not a problem since inter-tilling with corn and other crops will allow for increased extension of land if further increased

production is needed to meet the added demands. Although beans are produced throughout the country the principal producing areas are the departments of Santa Ana, La Libertad and San Vicente.

TABLE XX--AREA AND PRODUCTION OF BEANS FROM 1950/51 TO 1959/60

(Area in thousands of hectares; Production in thousands of quintals.)

YEAR	AREA	PRODUCTION
1950/51	41	867
1951/52	35	655
1952/53	37	716
1953/54	34	625
1954/55	34	626
1955/56	34	606
1956/57	27	406
1957/58	25	292
1958/59	17	226
1959/60	21	222

Sources: El Salvador, Ministerio de Agricultura y Ganadería, Panoráma General de la Producción, Distribución y Consumo de los Principales Renglones Agropecuarios, San Salvador, 1957, p. 5.; and El Salvador, Ministerio de Agricultura y Ganaderia, Informe, San Salvador, 1960, Anexo No. 9-9.

Maicillo (Sorghum)

Planted immediately following the first crop of corn, maicillo is more resistant to drought. During the early 1950's, production increased considerably, but as in the case of other basic food crops, production has varied in recent years due to unfavorable climatic conditions (see Table XXI). Maicillo is used in feedstuffs for livestock and to some extent for human consumption.

Rice

Recent import data would indicate that rice is gaining in importance as a basic food item. Rice is grown throughout the country

TABLE XXI—AREA AND PRODUCTION OF MAICILLO AND RICE

FROM 1950/51 TO 1959/60

(Area in thousands of hectares; Production in thousands of quintals.)

RICE	AREA		PRODUCTION	
	RICE	MAICILLO	RICE	MAICILLO
1950/51	14	73	302	1,684
1951/52	16	69	367	1,745
1952/53	17	83	383	1,942
1953/54	21	93	487	2,204
1954/55	20	97	477	2,389
1955/56	17	95	416	2,251
1956/57	16	97	393	2,514
1957/58	15	83	319	1,876
1958/59	12	89	260	1,689
1959/60	9	84	265	1,628

Sources: El Salvador, Ministerio de Agricultura y Ganaderia, Panorama General de la Produccion, Distribucion y Consumo de los Principales Renglones Agropecuarios, San Salvador, 1957, p. 5.; and El Salvador, Ministerio de Agricultura y Ganaderia, Informe, San Salvador, 1960, Anex No. 9-12.

usually on small farms, with the center of production in the Zona Central where more than 50 per cent of the crop is grown, while approximately 25 per cent is produced in the Zona Oriental. As in the case of the other basic food crops the extent of land under rice production has declined considerably due to the increased production of cotton. Although yields have increased due to the introduction of new varieties of rice and the increased application of irrigation, the over-all production is still insufficient and considerable amounts have had to be imported in recent years. Imports amounted to 34,440 quintals in 1958, and increased almost three times in 1959, to 90,940 quintals. With the opening of new highways and feeder roads, particularly in the coastal regions of Usulután, new land will be brought under cultivation and the production of rice will be increased.

Livestock and Dairy Production

The livestock industry of El Salvador is still small, but during the last ten years there has been some development toward increased production of meat as well as milk. The 1952 census lists the following numbers and types of livestock for the Republic.

TABLE XXII--DISTRIBUTION OF LIVESTOCK IN EL SALVADOR IN 1952

TYPE	TOTAL	ZONES WEST	CENTRAL	EAST
Cattle	825,461	150,105	369,265	30,691
Horses	122,224	28,940	54,912	38,372
Mules	37,290	7,881	20,041	9,368
Donkeys	3,113	666	1,212	1,235
Goats	18,677	1,966	9,197	7,514
Sheep	4,075	921	2,679	475
Pigs	418,679	59,523	195,388	163,768

Source: W.E. Ranck, La Industría de la Carne en El Salvador, Circular Agrícola No. 70, Santa Tecla, E.S., 1954, p. 16

Of the Republic's 43,148 agricultural holdings with livestock, 16,905, or about 40 per cent are located in eastern El Salvador. The department of San Miguel has the largest number of cattle, and is third in the number of pigs. The department of La Union is the first in the number of goats, second in the number of donkeys and pigs, and third in the number of cattle, while the department of Usulután has the second largest number of horses.

By 1957, cattle had passed the one million mark and today the numbers continue to increase slowly. This modest progress is due in part to improved methods employed in the administration, feeding, and breeding of cattle. However, El Salvador's cattle are still largely range-fed with very little supplementary feed, particularly needed

during the dry season.

At present pasture and range land make up approximately 30 per cent of the Republic, or roughly 685,000 has. of which an estimated 17,000 has. are improved pasture land (see Figure 29). According to Dr. Neil C. Fine, Technical Advisor for Point IV Program, the density of cattle per hectar, is very high, and any improvement in milk and meat production in the future will have to come from increased efficiency in production and not through an increase in numbers of animals.[33] This would mean that the cattle would have to be provided with better feed throughout the year and particularly during the dry season. Thompson suggests that malnutrition is responsible for sterility in 10 per cent of the cows and that aside from causing slow sexual maturation, it contributes to a low (40 to 45 per cent) annual calving rate.[34] Calf mortality rates are high, around 35 to 40 per cent, and are also caused, at least in part, by malnutrition. During the dry season when the range, which is reasonably good during the rainy season, deteriorates, death among the cattle population is common and many of the animals lose as much as 25 per cent of their weight. Green feed or supplements, particularly during the dry season, are limited to few milk herds belonging to more enlightened owners.

Increased attention is given to improvement of the common cattle or the <u>criollo</u>, by controlled breeding. Cross-breeding for range cattle and imported purebred dairy cattle, is generally done with the

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[33] N.C.Fine, "Ganado de Carne", Agricultura en El Salvador, Año I, No. 3, San Salvador, 1960, p. 5.

[34] J. Thompson, "Production, Marketing, and Consumption of Cattle in El Salvador, The Professional Geographer, Journal of the Association of American Geographers, Vol. XIII, No. 5, 1961, p. 19.

Fig. 29.--Native cattle, called criollos, graze on unimproved pasture land, known as morrales.

Fig. 30.--Increased attention is given to the cross-breeding of native cattle and imported purebred cattle. The cross between <u>zebu</u> and <u>criollo</u> produces a strong and healthy breed.

hardy Zebu (see Figure 30) and the Santa Gertrudis strains. In general, however, breeding is uncontrolled and increased efficiency is needed for better and faster results.

Another small step forward in the development of the livestock industry is a slow improvement of slaughter house facilities, which are at present usually small, poorly constructed, unscreened structures. Increased attention is also being given to refrigeration, and a better system of distribution of meats is being attempted, at least in the bigger cities. The annual slaughter in El Salvador averages about one hundred thousand cattle, two hundred thousand pigs, and a few hundred sheep and goats. Despite the low per capita meat consumption, which is estimated at anywhere from 27 lbs. per year[35] to 11.6 lbs per year,[36] El Salvador has to import some cattle and hogs from nearby Honduras and Guatemala.

No statistics regarding the present horse, hog, sheep, goat, mule, and donkey populations are available to indicate an increase or decrease over the past ten years. However, judging from the number of cattle, it might be concluded that there has also been a slight increase over the years.

The daily milk production for 1955, was estimated at 109,726 liters during the dry season and 212,530 liters during the rainy season, which is far from sufficient for a population of over two million people. Approximately 60 per cent of the total production is consumed as fluid milk, while the rest is used in the manufacture of dairy products,

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[35] W.E. Ranck, La Industria de la Carne en El Salvador, Circular Agricola No. 70, Santa Tecla, E.S., 1954, p. 3.

[36] Thompson, op. cit., p. 21.

particularly cheese. On the basis of these figures the daily average per capita consumption for the urban population alone, is less than 0.11 liters.

During the past ten years milk production has remained relatively stable, registering only a slight increase. The 1950 census registered some 202,407 milk cows, as compared to 198,794 in 1958. The slight increase is thus due to better methods employed in the care of the cows. One of four modern milk plants was put into operation outside San Miguel in 1959, and others are being planned and constructed in the larger cities in western El Salvador. The San Miguel plant processes an average of 6,361 kgs. of raw milk daily, partly for direct consumption and partly for the production of powdered milk, butter, cheese and ice cream. At present there are over six hundred dairy producers organized in dairy cooperatives throughout the country, and it is hoped that in time these organizations may provide a sufficient supply of milk and that dairy products may be made available and distributed throughout the country to fill all the requirements of the people.

PART II

THE AGRICULTURAL LANDSCAPE OF EASTERN EL SALVADOR

The chosen study area encompasses all of the major physiographic regions that are characteristic of the country as a whole. Aside from these, there are numerous landforms that lend particular aspects to the physiographic regions of eastern El Salvador, giving the area a character of its own. Within this region lives nearly one-third of the people of El Salvador who produce approximately two-thirds of the nation's cotton, one-fifth of its coffee, all of its henequen, and close to one-half of its basic food crop, maize.

Also within this region are large tracts of land available for agricultural use when opened by new highways and feeder roads, as well as areas more inaccessible and backward than anywhere else in the Republic. Through misuse in the past, large areas of eastern El Salvador have been completely destroyed for agricultural use for generations to come, and larger areas still exposed to misuse and the resulting effects of accelerated erosion, add to the already grave problem of providing for the rapidly increasing population.

All these factors have impressed on the region a character that sets eastern El Salvador apart from the rest of the country.

CHAPTER IV

THE FORMAL STRUCTURE OF EASTERN EL SALVADOR

The eastern zone represents an area of approximately 7,861 sq. kms. which may be divided into five regions. They are:

(A) The Jiquilisco Coastal Region,

(B) The San Miguel-Tecapa Volcanic Mountains,

(C) The Jucuaran-Conchagua Coastal Region,

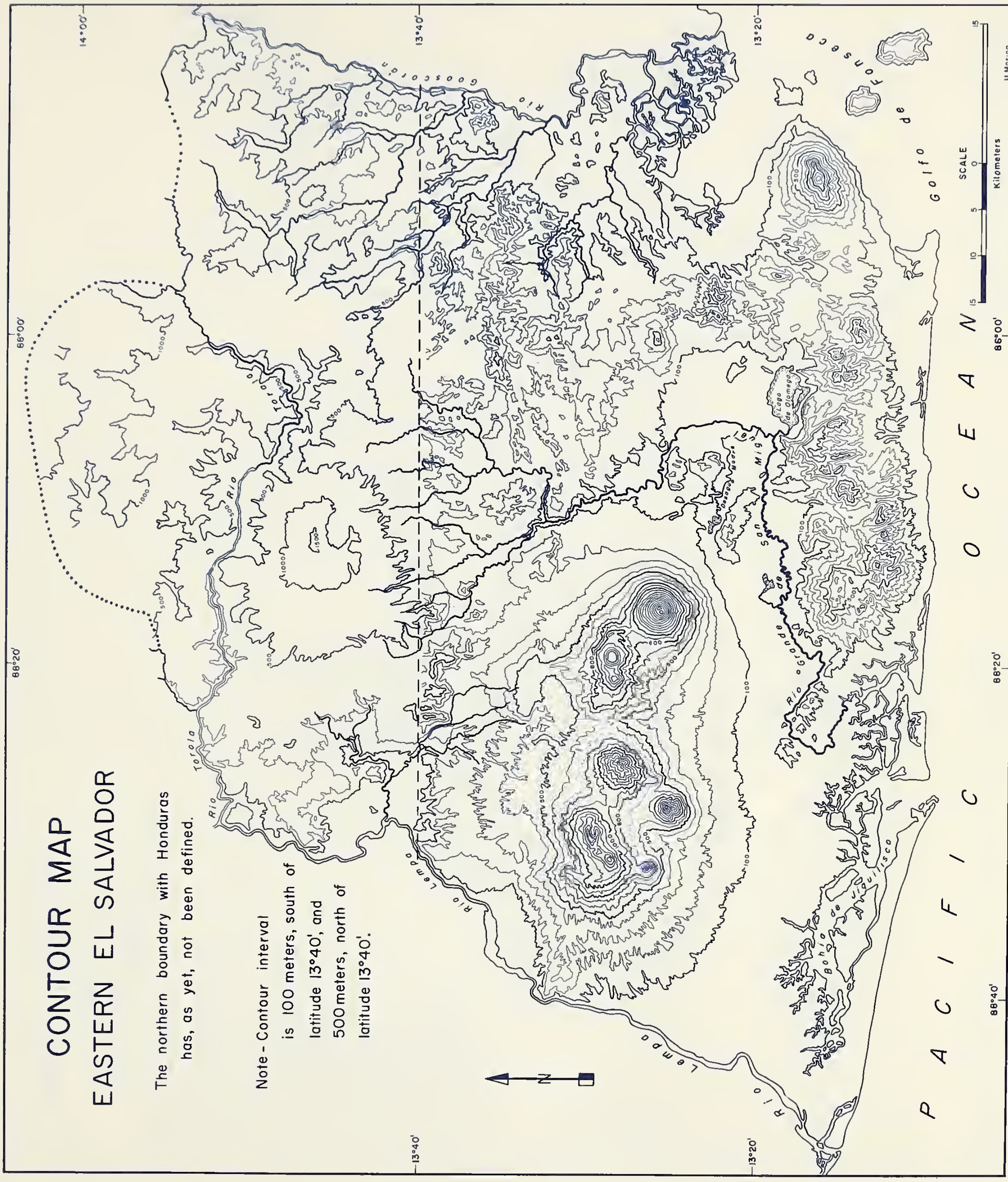
(D) The Interior Valley,

(E) The Northern Mountains and Foothills.

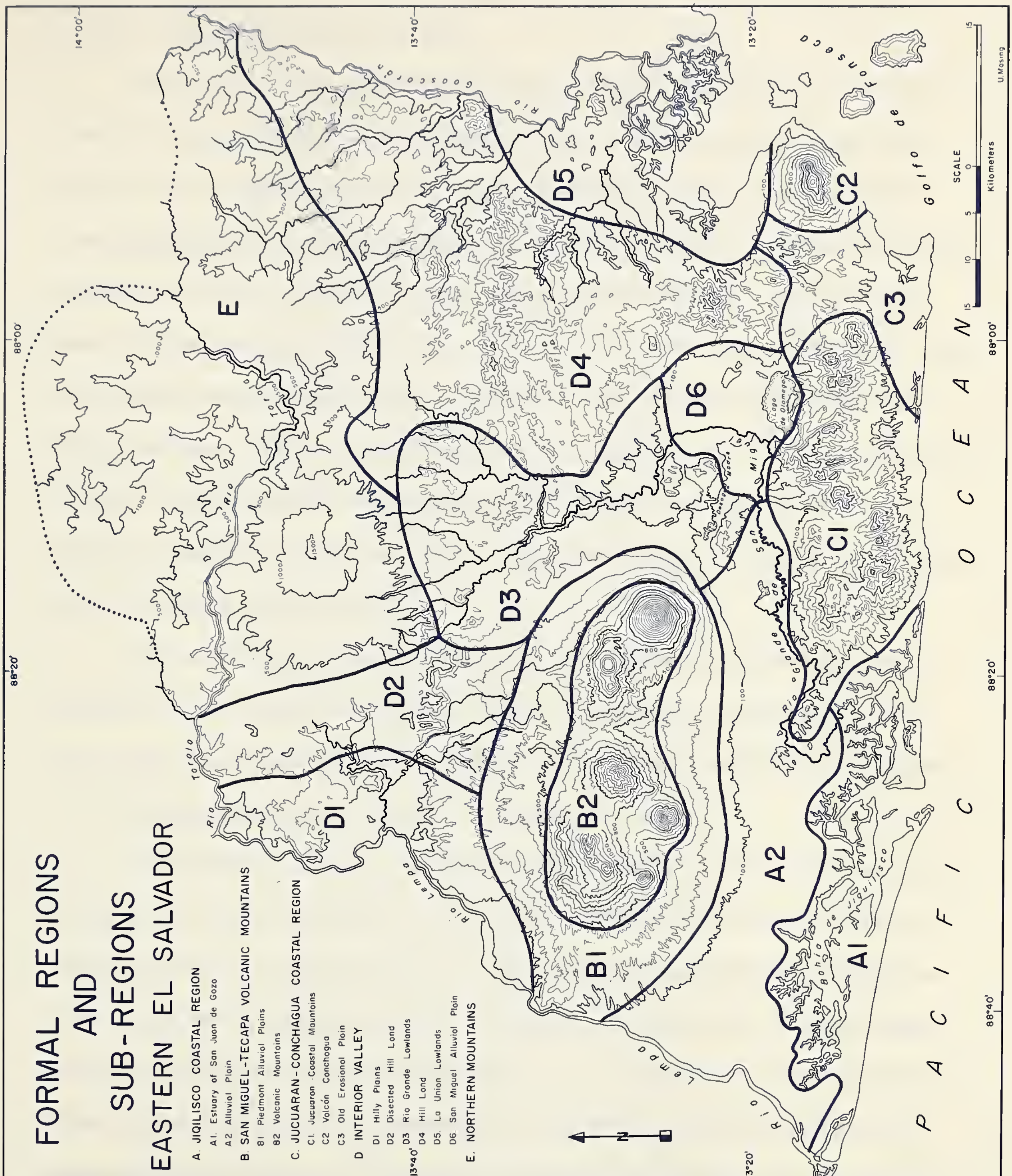
Of these regions, A,B,C, and D have been further divided into sub-regions (see Maps XIII and XIV).

The Jiquilisco Coastal Region (A)

The Jiquilisco Coastal Region is the name given to the coastal plain east of the Rio Lempa. The southern fringe of this region is formed by the San Juan del Gozo Estuary (A_1), an area approximately 50 kms. in length and 10 kms. in width, also known as the Bahia de Jiquilisco. Situated between the deltas of the Rio Lempa and the Rio Grande de San Miguel, the estuary is made up of a complex system of islands and channels bordered by extensive mangrove swamps or salinas, and protected from the open sea by offshore bars. These bars, the longest of which is the 40 kilometer-long peninsula of San Juan del


CONTOUR MAP
EASTERN EL SALVADOR
The northern boundary with Honduras has, as yet, not been defined.
Note - Contour interval is 100 meters, south of latitude 13°40', and 500 meters, north of latitude 13°40'.
N
Rio Torola
Rio Torola
Rio Goascorán
Rio Lempa
Rio Lempa
Rio Grande de San Miguel
Laguna de Olomega
Golfo de Fonseca
Bahia de Jiquilisco
PACIFIC OCEAN
SCALE
Kilometers
14°00'
13°40'
13°20'
88°20'
88°00'
88°40'

MAP XIII


FORMAL REGIONS
AND
SUB-REGIONS
EASTERN EL SALVADOR
A. JIQUILISCO COASTAL REGION
A1. Estuary of San Juan de Gozo
A2 Alluvial Plain
B. SAN MIGUEL-TECAPA VOLCANIC MOUNTAINS
B1 Piedmont Alluvial Plains
B2 Volcanic Mountains
C. JUCUARAN-CONCHAGUA COASTAL REGION
C1. Jucuaran Coastal Mountains
C2 Volcan Conchagua
C3 Old Erosional Plain
D INTERIOR VALLEY
D1 Hilly Plains
D2 Disected Hill Land
D3 Rio Grande Lowlands
D4 Hill Land
D5 La Union Lowlands
D6 San Miguel Alluvial Plain
E. NORTHERN MOUNTAINS
P A C I F I C O C E A N
Golfo de Fonseca
Rio Lempa
Rio Goascoran
Rio Grande de San Miguel
Bahia de Jiquilisco
Laguna de Olomega
SCALE
Kilometers
U. Masing

MAP XIV

Gozo, are formed by sediments from the Río Lempa and the Río Grande de San Miguel which are carried into the sea and deposited by an ocean current moving from west to east.

Much of the area between the bars and the mainland is low and too poorly drained to permit agricultural development and thus has been left in its original state of mangrove swamps. Among the mangroves the Rhizophora and the Avicennia are the most common species and reach heights of 15 ft. and more, with fairly thick trunks. The bars and some of the higher, better-drained areas are topped by sandy soils not very conducive to agriculture. However, the older beach ridges on Espíritu Santo Island provide some possibilities for limited agricultural use. The principal agricultural activities are the growing of cotton, coconuts, and some cacao, supplemented by fishing and gathering bark for tannin extraction.

The more recent beach ridges are covered with grass and joined farther inland where the ridges are older and the ground higher, by brush vegetation and scattered trees, among which particularly members of the Ficus species are the more common.

The northern fringe of the estuary gives way to an alluvial plain (A_2), which rises gradually toward the interior at an angle of two to three degrees, or approximately 5 ms. per km., and blends inconspicuously into the piedmont alluvial plains (B_1) of the San Miguel-Tecapa Mountains to the north. This gradual intermingling of slope and soil (see Figure 34) makes it impossible to draw an accurate boundary between the two regions. Thus, the line that has been drawn on Map XIV is strictly arbitrary, and follows approximately the 150 m. contour line. It should be pointed out that no pronounced differences exist on either side of the line.

The alluvial plain in its eastern sections is enclosed by the Jucuarán Coastal Mountains (C_1) and the piedmonts of the Volcán San Miguel, and is separated from the Río Grande lowlands (D_3) by an erosional remnant of an earlier northward extention of the Jucuarán Coastal Mountains. The gently sloping strip of alluvial plain covers an area about 65 kms. in length and 8 kms. in width. It is overlain by a variety of alluvial soils, depending on local drainage conditions, but for the most part they are deep, brown to brownish-black friable silt loams to clay loams overlying stratified deposits of clay, silts, sands, pumice, volcanic ash, gravel, and a mixture of these at a depth of 1 m. or more. The smooth surface of the plain is interrupted only by numerous parallel water courses crossing from the San Miguel-Tecapa Mountains to the estuary. During the dry season most of these stream courses are dry and are used as roads. Generally the drainage conditions are good with the more poorly drained areas located near the coast and in the valley of the Río Grande de San Miguel.

The poorly drained parts of the alluvial plain that have an abundance of ground water throughout the year were at one time covered with a luxuriant hydrophytic forest (wet forest of the plain), and closely resembled a tropical rainforest with the variety of species of trees and the dense undergrowth. Locally this forest is known as the _bosque de ojushte y huiscoyol_, after the more common species of trees. At one time these forests covered extensive areas of the lower alluvial plains (see Map VII), but today they are only small remnants of the original vegetation in scattered places. In time they too, will give way to the axe and make room for large-scale mechanized farming (see Figures 16 and 31).

Fig. 31.--The poorly drained parts of the alluvial plain that have an abundance of ground water throughout the year, were at one time covered with a luxuriant hydrophytic forest and closely resembled a tropical rainforest. Today there are only small remnants of the original vegetation in scattered places. In time they will completely disappear and make room for cotton and corn farming.

Fig. 32.--The San Miguel-Tecapa Mountains seen from the Pan American Highway. In center of picture are the settlements of Nueva Guadalupe in the foreground, and Chinameca in the background, against the Volcán Chinameca. To the right are the settlements of San Buenaventura in the foreground, and Jucuapa in the background, huddled against the Volcán El Tigre. At far right of picture the peak of the Volcán Tecapa is visible above the horizon. To the far left in the distance is the Volcán San Miguel.

The alluvial plains are known as the bread basket of the country. Here there are large haciendas well adapted to modern mechanized agriculture (see Figure 34). Approximately 40 per cent of all cotton is produced in the northern part of the alluvial plain, directly adjacent to the new littoral highway. The southern part of the plain is principally dedicated to livestock production, utilizing good pasture lands throughout the year. Aside from cotton and livestock, corn and rice comprise the principal food crops. There is no doubt that the alluvial plain is one of the most productive areas of cotton, corn, and rice, within the Republic.

The San Miguel-Tecapa Volcanic Mountains (B)

These mountains are part of the Pleistocene volcanoes that traverse the country from east to west and form the backbone of the Republic. They form the eastern cluster of the Cadena Costera and are made up of twelve volcanoes surrounded by dissected, and in places, somewhat irregular, piedmont alluvial plains (see Figure 32).

The piedmont alluvial plains (B_1) on the south-facing slopes of the mountains rise gently out of the coastal plain at approximately 150 ms. to an elevation averaging around 400 ms. above sea level. On the north and east-facing slopes where the mountains border on the Interior Valley (D), the piedmonts ascend higher along the slopes and tend to be steeper in places due to the relatively higher elevation of the Great Interior Valley. In their lower parts the piedmonts tend to be relatively smooth with slopes not exceeding five per cent, and with a local relief between 5 and 10 ms.. Numerous streams and narrow, shallow quebradas (ravines) cross the plains at irregular intervals of

Fig. 33.--Volcán San Miguel and Volcán Chinameca seen from the Pan American Highway. The San Miguel is the highest of the eastern-most group of volcanoes. Behind the Volcán Chinameca in the center of the picture is the Volcán El Tigre. The foreground is part of the Great Interior Valley.

200 to 600 ms. apart. With increasing elevation erosion becomes more pronounced giving the piedmonts a more strongly dissected appearance. The local relief increases rapidly to as much as 30 ms. with slopes as steep as 70 per cent and more in some places.

Similar to the volcanoes from which they are formed the piedmonts are mantled with volcanic ash and dust. In their lower parts they are covered with fairly deep, reddish-brown to dark brown clay loams and clays, with good water storage capacity. At higher elevations and with increasingly steep slopes, where the soils thin out, much of the top soil has been lost through accelerated erosion, exposing a reddish clay subsoil or bare rock.

Land use varies throughout the piedmont from very intensive crop cultivation to grazing, depending on the local topography and previous use. The most common crops are corn, beans, rice, and sugar cane with some henequen on the lower northern slopes of the Volcan San Miguel. Coffee is cultivated on the higher slopes above the 350 meter level and occupies most of the mountain slopes.

The volcanic mountains (B_2) of the San Miguel-Tecapa range are composed of twelve volcanoes loosely associated in three large groups. The eastern San Miguel group is comprised of three volcanoes of which the San Miguel and the Chinameca are joined by a 900 meter-high saddle approximately 7 kms. long (see Figure 33). San Miguel Volcano (2,129 ms.) is the highest of the eastern group and the third highest of the Republic. Because of its nearly perfect symmetrical shape (see Figure 34) the <u>volcán</u> is by many considered to be the most beautiful of El Salvador's volcanoes. The western Tecapa group is made up of six volcanoes with El Tigre (1,658 ms.) (see Figure 32) and Tecapa (1,603 ms.) the

highest. These two groups are approximately 15 kms. apart and are joined by a 600 meter-high saddle. Directly to the south of the Tecapa group is a cluster of three isolated volcanoes of which the Usulután (1,453 ms.) is the highest and most southern.

The San Miguel-Tecapa mountains are of relatively recent geologic age and comparatively better preserved than the older volcanic mountains of the north. They are comprised of andesites, basalts, and conglomerates of clay, and diverse pyroclastic materials of the surrounding volcanoes. To the east the range ends with the Volcán San Miguel which has continued active throughout historic times, pouring forth clouds of steam and sulphur at irregular intervals.

The soils of the mountains vary greatly from place to place, depending on slope and vegetation cover. The most common soil typical to large parts of this area is a brown to brownish-black silt loam, fairly rich in humus, formed under forest vegetation. Although under cultivation they have been preserved in a fairly natural state. These soils have a good water storage capacity aided by the tree cover which decreases evaporation during the dry season. Most of the mountain slopes above the 350 meter level are under coffee cultivation (see Figure 35). Coffee trees have replaced most of the natural forest cover with the exception of those used as shade trees for the coffee.

The Jucuarán-Conchágua Coastal Region (C)

This region takes in the area along the coast from the delta of the Río Grande de San Miguel to the south-eastern tip of the country at the Gulf of Fonseca. To the north the coastal region borders the central uplands (D) and the eastern extention of the alluvial plains (A_2).

Fig. 34.--Volcán San Miguel seen from the south. Note the lava field in the center of the picture and the pattern of large land holdings.

Fig. 35.--Upper slopes of Volcán San Miguel under coffee cultivation. Lava field on the north slope of the volcano sparsely covered with grass and few trees.

The Jucuarán Coastal Mountains (C_1) are hemmed in between the Pacific Ocean on the south and the Río Grande de San Miguel and Lago de Olomega to the north. The mountains are comprised of strongly cemented, stratified volcanic materials, predominantly andesites and basalts, intermingled with scoria and other pyroclastic materials of a geologic age older than that of the San Miguel-Tecapa mountains, and probably dating back to the Tertiary. Morphologically the region is extremely complex, and can best be described as an array of peaks, hills, valleys, plateaus, intermontane basins, and slopes and ridges (see Map 13). The topography is rough and broken with rugged slopes predominating over level land. The northern parts are generally more rugged, higher, and less suited for agriculture than the southern lower valleys and piedmonts. Isolated peaks reach heights of 800 ms. and more. The rugged ridges of the north gradually slope toward the coast where they form a precipitous coastline with a narrow strip of sandy beach for approximately 20 kms. between the Playa El Espino and Punta Conchagüita. East of Conchagüita the mountains retreat from the coast and merge with the peneplain (C_3).

The soils covering this region are for the most part dark brown to reddish brown clay loams derived directly from the underlying rocks. In the higher elevations where steep slopes and excessive surface drainage are the rule they tend to be very shallow and stony. Erosion is a great problem and the primitive _milpa_ agriculture practiced on the steep slopes contributes much to the ruin of the area. Corn and _maicillo_ are the only crops grown with extremely low yields.

Within the intermontane basins the low, narrow valleys of the southern slopes and the alluvial fans east of Conchagüita, the soils

are formed from alluvial deposits and as a rule deep sandy clays with good water retention, which are moderately fertile. Aside from the basic food crops of corn and beans, cotton is the chief commercial crop. However, the available amount of level land suited for mechanized farming is limited.

As a rule the lower parts of the region are given over to subsistence farming while the higher areas and steep slopes, unless completely denuded of soil, support some milpas and poor remnants of the original dry deciduous forest and grass. Growth is limited to the rainy season which gives the landscape a brown, dry appearance during the dry season (see Figure 11).

The Volcán Conchágua (C_2) is the most eastern of the chain of volcanoes traversing the Republic. Conchágua is roughly circular in outline and has three peaks separated by approximately 1 to 1.5 kms.. Of these, the central Cerro Ocotal (1,243 ms.) is the highest followed closely by the Cerro Conchágua (1,157 ms.) to the east. Numerous streams have carved the volcano into a mountain mass of great ruggedness (see Figure 36), composed of lava flows of basalts and andesites covered with other volcanic materials. The amount of erosion points to a probably older geologic age than the other volcanoes of the same chain. Conchágua rises steeply out of the Gulf of Fonseca, with slopes ranging from 25 per cent to more than 100 per cent and very high local relief.

On the lower, westward-facing piedmonts, where the slope does not exceed 60 to 70 per cent the soils are a reddish clay, moderately deep and in places shallow and stony, depending on the amount of slope and previous use of the land. On the upper slopes of the volcano where the soils have remained under a forest cover, they are deep and rich in

Fig. 36.--North-east slope of Volcán Conchágua. Numerous streams have carved the volcano into a mountain mass of great ruggedness. Seen from the port of La Union, south-east of La Union.

humus, similar to the soils of the San Miguel-Tecapa volcanic mountains (B_2). The upper slopes of the Conchágua belong to the climatic zone of the *tierra templada*, and large areas are still covered by the original oak and pine forests. Of the dry deciduous forest that once covered the lower slopes of the volcano only remnants remain, with much of the area given over to coffee. The westward-facing piedmonts are comparatively low and blend inconspicuously into the old erosional plain (C_3) (see Figure 4), separating the Volcan Conchágua from the Jucuarán Coastal Mountains (C_1).

To the south and east the Jucuarán Coastal Mountains gradually merge into an old erosional plain (C_3) upon which erosional remnants of the coastal mountains have been left standing, giving the area its local relief. Tectonic movements of the past have modified the plain to a degree where its elevation ranges from near sea level to over 200 ms. above sea level. Numerous deep *quebrades* (ravines) cross the plain at irregular intervals. Most of the land is comparatively level with a relief rarely exceeding 30 ms. and slopes usually under 10 per cent.

The peneplain is underlain by strongly cemented lavas and congolmerates of basalts and andesites, with some areas composed of colluvial and alluvial materials from the slopes of the surrounding mountains. The soils are for the most part, reddish brown clay soils, fairly deep, with good water storage capacity and moderately fertile. The lower areas, where colluvial and alluvial materials form the parent materials the soils range from dark brown or reddish brown clay loams or clays, to poorly drained gray-black or black clay soils.

Of the original vegetation of dry deciduous forest and low quality grass which covered most of the old erosional plain, nothing is left but a few isolated shade trees for man and beast. The same is true of the

narrow coastal strip which was at one time inhabited by Wet Forest of the Plain. A considerable area east of the Lago de Olomega and along the southern periphery of the Amapala Peninsula has black to gray clay soils covered by a scrub and thorn forest.

Agriculturally the peneplain is vastly superior to the mountains to the west (C_1). The level valley bottoms and the gentle slopes are largely used for cotton production while the steeper slopes and the small stoney patches of level land are left to the small farmer and his milpas (see Figures 4 and 25).

The Interior Valley (D)

The Interior valley is a continuation of the Great Interior Valley which traverses the Republic from the border of Guatemala to the Río Goascorán and the Gulf of Fonseca. Most of the Interior Valley is an upland area situated between 200 and 300 ms. above sea level, although there are isolated erosional remnants of hills and mountains, attaining elevations of over 600 ms. (see Figure 37).

Bordered in the south by the piedmont plains (B_1) of the San Miguel-Tecapa Mountains (see Figures 32 and 33) and the Jucuarán-Conchágua Coastal Region (C), and in the north by the Northern Mountains (E), the Interior Valley is in a stage of transformation with the characteristic dendritic drainage pattern and presents an area of broken topography with numerous strongly dissected clusters of hills, mountains, ridges, and relatively few areas of level land not crossed by quebradas and barrancas. Soil erosion is strongly evident throughout the area and presents a great problem about which very little has been done (see Figures 38 and 39).

Fig. 37.— The Río Grande Lowlands (D_3) are composed of a series of broad river valleys above which rise at intervals strongly disected hills and ridges which provide most of the local relief.

Fig. 38.--Erosion on Hacienda San Andrés, approximately 7 kms. north-west from San Miguel on the Pan American Highway.

Fig. 39.--Hacienda San Andrés. To stop the downcutting Inspector Sr. Jule is building dams across the larger gullies.

The pattern of topography is so intricate that a great detailing of the various areas has not been attempted due to lack of adequate map coverage on a scale of 1:50,000. However, some broad differences in landforms are apparent. East of the Río Lempa, between the mouth of the Río Torola and the Cuzcatlán Bridge there is a narrow strip of hilly plains (D_1) with two large river terraces along the Río Lempa, one south of the bridge and the other just north of La Pintada (see Figure 40). The elevation and the local relief of the region are relatively low but increase sharply with distance from the river. The landscape assumes the character of a strongly dissected hill land(D_2) which reaches its highest elevation of over 500 ms. along a line running north from Lolotique through Sesori to San Gerardo south of the Río Torola. The southern part of this hill land forms the divide between rivers draining into the Río Lempa and the western tributaries of the Río Grande de San Miguel. To the east of the divide the topography gradually levels out, but continues to exhibit a rather hilly character until it reaches the lower valleys of the Río Grande Lowlands (D_3) just west of the road between Moncágua and Chapeltique (see Figure 37).

The Río Grande Lowlands (D_3) are composed of a series of broad river valleys ranging in elevation from 100 to 200 ms.. These plains form a base above which rise, at close intervals, strongly dissected hills and ridges which provide most of the local relief.

To the east of the lowlands the landscape again assumes a strongly dissected mountainous character with local elevations of over 600 ms.. This hilly (D_4) area is similar in character to the hill land (D_2) but covers a larger area and contains ramnants of old plains. In the north the Río Grande Lowlands border the Northern Mountains (E) along a line

running north-east from San Francisco Gotera to Sociedad, Anamoros and Nueva Concepcíon Oriente. To the south it continues as a narrow chain of isolated peaks and ridges of varying heights interrupted by numerous upland plains badly dissected and deformed, to again increase in elevation in its southern extremity (see Figure 41) where it gradually merges with the old erosional plain (C_3). This hill land forms the divide between the eastern tributaries of the Río Grande de San Miguel and the rivers draining into the Río Goascorán and the Gulf of Fonseca.

The streams that drain from the hill land (D_4) into the Río Goascorán and the gulf have made the transition from the hill land to the La Union Lowland (D_5) a gradual one. As the hills descend toward the gulf the interfluves become narrower and lower, and the amount of level land increases. Erosional remnants become more isolated and decrease in elevation until level areas dominate the landscape. The lowlands constitute an area roughly semi-circular in shape around the Bahia de La Unión and are remnants of old erosional plains, heavily dissected by numerous small quebradas.

Some 8 kms. south-east of San Miguel the Río Grande Lowlands (D_3) merge with the San Miguel Alluvial Plain (D_6). This is an old floodplain of the Río Grande de San Miguel and stands about 60 ms. above sea level (see Figure 42). The plain is nearly flat and large parts of it are vulnerable to flooding after heavy temporales, particularly those areas close to the Río Grande de San Miguel where flooding is a yearly occurence.

Most of the Interior Valley is underlain by materials of volcanic origin, basalts, andesites, and volcanic ash being the most common. Along the river valleys and the delta of the Río Goascorán the materials are alluvial deposites. The typical soils of the uplands are shallow

Fig. 40.--River terrace of the Río Lempa north of the Cuzcatlán Bridge.

Fig. 41.--The southern extremity of the hill land (D_4) seen from the Pan American Highway west of La Union.

red clays extremely rocky in places. Land use may vary from intensive mechanized farming to milpa agriculture and grazing, depending on the topography and the past history of use. Erosion is apparent throughout the central uplands and is rapidly diminishing the amount of cultivable land.

The hill lands (D_1, D_2, D_4) are by and large mantled with a combination of soils varying from black to reddish clays. In the lower more level areas where the drainage is poor, dark clay soils are more frequent, while undulating areas and erosional remnants tend to be covered more with shallow reddish clay soils extremely stony in places. Most of the hill lands are given over to intensive subsistance milpa agriculture and some grazing. Of particular interest is the hill land (D_4) north of the Military Highway and east of San Francisco Gotera. While in the rest of the hill lands deforestation was the result of milpa agriculture, here complete destruction of the forest cover was achieved by the numerous mines, which at one time existed in these areas, in their utilization of firewood. Today the area is little more than a barren desert (see Figure 43) with meager patches of shrubs and brush covering some of the slopes not used by milpa farmers. As a result of complete deforestation the water table has been lowered and accelerated erosion has left nothing but stone-covered hills and gravelly or sandy valley bottoms and plains. Poverty and distress are the daily companions of the people of this area, for the little they harvest is far from sufficient for their needs.

The soils of the Río Grande Lowlands (D_3) differ little from those of their neighboring hill lands and are for the most part reddish clays, somewhat deeper and less stony. In the valleys and level interfluves east of San Miguel, large tracts of land are used for extensive henequen plantations, but elsewhere corn, beans, maicillo, rice, sugar cane, and grazing are the chief products. The more broken terrain with stony soils

Fig. 42.--San Miguel Alluvial Plains (D6). All-weather gravel road passes through the *Hacienda* El Delirio, and connects with the littoral highway. Erosional remnants in background.

Fig. 43.--Hill land (D_4) in the vicinity of Santa Rosa de Lima, one of the driest and hottest parts of eastern El Salvador. It was approximately one hundred years ago that much of this area was still forested.

is either left to a scant second growth of brush or used for pasture land. Erosion is a serious problem particularly in the Río Grande Lowlands where intensive clean crop cultivation is practiced and the plains slope sufficiently to permit rapid runoff during the rainy season.

In the La Union Lowlands (D_5) the common black clay soils are associated with characteristic thorn and scrub vegetation and a sparce grass cover. These morros as they are locally known, are situated between the Río Amatilla and Puente Goascorán and are mainly used for extensive grazing lands (see Figure 29). In the southern parts of the lowlands where they merge with the old erosional plains (C_3) the soils are more sandy and lend themselves to intensive large-scale mechanized agriculture. Cotton and basic food crops are the main products, restricted to the better drained parts of the lowlands. With improved drainage, the use of fertilizer, and new types of crops, these floodplains can be made highly productive. Similar in nature are the soils of the poorly drained lowlands of San Miguel (D_6) where soils range from poorly drained heavy dark clays to gray brown sandy clays. The areas of dark clay are largely morros while the sandy soils of the floodplains are very fertile and lend themselves to intensive mechanized farming with proper drainage and protection from flooding, which is not an easy task in this flat plain. At present most of the plain is used for grazing, particularly the floodplains, which remain moist enough throughout the dry season to provide adequate forage throughout the year.

The Northern Mountains (E)

The Northern Mountains that form the boundary between Honduras

and eastern El Salvador are as yet little known. They are geologically older than the Cadena Costera and belong to the mountain ranges of Honduras with the exception of the Volcan Cacaguatique which is one of the oldest volcanoes of the country. The topography of the region is an extremely complex system of strongly eroded and dissected hills and mountains increasing in elevation toward the border of Honduras. Most of the land is in steep slope with very little level land (see Figures 22 and 62). The Volcan Cacaguatique has been largely destroyed by erosion and has more the appearance of a strongly dissected mountain highland than of a volcano.

The soils of this area appear to be similar to those of the hill lands (D_2,D_4), rather shallow and stony red clays, particularly on the steep slopes where a milpa system of agriculture is accelerating the process of soil erosion. The higher areas of this region, pertaining to the tierra templada and tierra fria have lost most of their natural forest cover, particularly in the department of Morazan where the milpa system has devastated large parts of the department to such an extent that not even grass will grow any more. The slopes of the Cacaguatique mountains are to some degree under coffee cultivation and thus have retained most of their original soils. Aside from coffee the people cultivate corn, maicillo, and sugar cane, with very meager results. It was here that I encountered the most backward and hopeless people of El Salvador.

In summary it may be stated that the formal structure of the agricultural landscape, within the framework of the studied regions, has in general been determined by the physical elements which have been greatly altered and transformed by the rapidly increasing and expanding population and the resulting changes in the functional structure of the

landscape. Being one of the most densely settled countries of the Americas it is quite understandable that the amount of land under use and misuse is quite considerable. A steadily increasing population has gradually destroyed most of the country's natural vegetation and exposed large parts of the country to accelerated erosion, which has greatly altered the character of the formal landscape.

CHAPTER V

THE FUNCTIONAL STRUCTURE OF THE LANDSCAPE

Similar to the manner in which the increasing population has affected the formal pattern of the physical regions, the functional structure has greatly influenced the distributional pattern of the population.

Land Occupance

After the conquest all of the land became the property of the Spanish Crown, or realengas.[1] The early Spaniards introduced a concept of land tenure which was similar to the pre-colonial land ownership pattern of the Indians, the village with surrounding communal land called the ejido. The ejido is a village or a community with a certain amount of land alotted to it by the Government, which is held communally by the people of the village. The size of the land alotted to the village depends on the number of families in the community and the quality of the land. Each family head or ejidatario in the village is granted a certain amount of land and the right to work it and receive the benefits of his labor. The ejidatario does not hold title to the land and is not permitted to sell, lease, mortgage, or otherwise dispose of his right. In time most of the Indian villages received land grants by

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[1] W. Lauer, Vegetation, Landnutzung und Agrarpotential in El Salvador, Band XVI, Heft 1, Kiel, 1956, p. 73.

royal decree and thus became established as _ejidos_. However, side by side with the _ejidos_, and in marked contrast to them, another system of land tenure, that of the large and medium-sized private holding or _hacienda_ came into being, also by royal decree, or by purchase. Due to lack of adequate surveys conflict of ownership often arose so that lands and settlements which had originally been established as _ejidos_ were often incorporated into large private land holdings. By the end of the sixteenth century most of the desireable agricultural land was almost exclusively in the hands of a few wealthy families who had either purchased the land directly from the Crown, or received it as a grant from the Spanish Crown. Scattered among the large _haciendas_ were also a considerable number of small and medium-sized holdings or _ranchos_ belonging to _mestizos_, or Indians, who had remained owners of their land.

Due to their more favorable climatic and agricultural conditions, the lower piedmonts of the volcanic mountains and the wide, flat river valleys of the interior were the first areas to be settled by Spaniards, and they have continued to be the most densely populated areas of the Republic (see Map X). All land which was not in _ejidos_, _haciendas_, or _ranchos_, and this included the rougher and less readily accessible areas as well as the lower coastal plains, remained as _realengas_ until Independence (1821) when they became public domain of the Government of El Salvador. With increasing population and mounting pressure for land most of the public domain by 1827, had been taken over by the _ejidos_. However, this trend was reversed by the end of the nineteenth century when coffee assumed great importance. Demands for more land by a population that had almost tripled during the last century and particularly the demand for more coffee land, brought about the dissolving

of the ejido system through enabling revision of legislation and the sale of all communal lands. As a result almost all land in El Salvador is now privately owned.

Thus the oldest private land holdings, mostly large haciendas, were located in the fertile piedmont plains and valleys, while the more recently acquired holdings from Government or ejido lands, are mostly in the rough hill lands and on the higher slopes. Only where the land was suitable for coffee production did it provide the new owners with adequate returns. In contrast the fertile coastal plains which were covered by a wet forest of the plains and relatively poorly drained during the rainy season had discouraged settlement and remained in a natural state till comparatively recent times.

An increased demand for cotton and corn land has been responsible for the clearing of most of the plains during the last decade. Due to high initial capital investment in clearing of the forest and preparation of the land for cultivation, most of the lands are in the hands of fourteen wealthy families and consequently fairly sparsely settled.

As a result of the events outlined above, the small farmers of El Salvador referred to in the census as colonos, are in their majority primitive milpa farmers who occupy tiny plots, usually less than one hectare, of former ejidal land. Much of this land is not suited for clean crop cultivation because of slope conditions, least of all a primitive milpa agriculture. On the other hand, the extensive areas of desirable agricultural lands are largely in the hands of relatively few owners, and the small farmer must often seek part-time employment with the large land owner to supplement his living.

The 1950 census listed a total of 174,204 agricultural holdings or explotaciones, throughout the Republic (see Table XXIII), which were

grouped into four classes on the basis of size and use, with names corresponding to local usage. They are:

Finca: larger than 1 manzana and used for the cultivation of tree crops such as coffee, cacao, fruit trees, etc.. However, all holdings under coffee cultivation regardless of size are considered to be fincas.

Hacienda: more than 60 manzanas and used for the production of livestock including dairy cattle, for annual crops such as cereals, cotton, etc., and permanent crops such as henequen and/or both.

Granja: similar in its use to the hacienda but less than 60 manzanas and more than 1 manzana in size.

Terreno: all holdings less than 1 manzana in size and used for agricultural production, with the exception of coffee.

TABLE XXIII--AGRICULTURAL HOLDINGS IN EL SALVADOR IN 1950

ZONE	TOTAL	FINCAS	HACIENDAS	GRANJAS	TERRENOS
Occidental	35,316	5,802	925	1,368	27,221
Central	81,387	8,250	1,636	5,057	66,444
Oriental[a]	57,501	3,893	1,179	4,893	47,536
Total Republic	174,204	17,945	3,740	11,318	141,201

[a] Compare to the rest of the country.

Source: El Salvador, Ministerio de Economía, Atlas Censal, San Salvador, 1952, p. 45.

Of the total agricultural holdings of the country 57,501 or 33 per cent are within eastern El Salvador and cover an estimated area of 492,868 hectares (see Table XXIV). It is interesting to note that the 47,536 terrenos which make up 82.7 per cent of the holdings of eastern

El Salvador occupy only 34.6 per cent of the land while the 5,072 <u>fincas</u> and <u>haciendas</u> which constitute only eight per cent of all holdings occupy 50.9 per cent of the land. Further it should be noted that approximately 60 per cent of the <u>terrenos</u> are not owned by the people who work them, but are parcels of land either leased by the operators or worked by <u>colonos</u>, farm workers, who have some land alotted to them for the production of food crops. From Tables XXIII and XXIV it is apparent that a small number of <u>hacendados</u> and <u>finqueros</u> not only own most of the land, but also the best land.

TABLE XXIV--AREA OF AGRICULTURAL HOLDINGS OF EASTERN EL SALVADOR IN 1950

(in hectares)

TOTAL AREA	FINCAS	HACIENDAS	GRANJAS	TERRENOS
492,868	41,824	208,893	71,455	170,606
Percentage of total area:	(8.5%)	(42.4%)	(14.5%)	(34.6%)

<u>Source:</u> Same as Table XXIII., p. 46.

As has been stated previously most of the land in El Salvador is privately owned. The operators of the 174,204 agricultural holdings listed in the 1950 census are people directly concerned with the management, financially and administratively, on either privately owned, rented, or communally held land. Of these, 61.92 per cent are proprietors, 18.92 per cent are lessees, and 19.16 per cent are workers living on and off land owned by their employers. Although the census lists 61.92 per cent of the farm operators as owners, I have found little evidence which points towards a class of small-scale independent farmers. The only small-scale farmers I encountered were in the mountain areas of the

north and along the coast, as well as on the lower slopes of the San Miguel-Tecapa mountain range. These small-scale farmers usually occupy the marginal lands that should not be used agriculturally, and are so little suited to farming that the large land owners have little interest. In reality there are only two social classes among the rural people: the hacendados, large estate owners, and the colonos, the workers. This fact becomes particularly evident from the distribution of land used for the production of export crops (see Tables XXV and XXVI). The 120,140 of the Republic's hectares planted to coffee are divided into an estimated 12,000 coffee fincas, ranging in size from less than 1 manzana to more than 100 manzanas. About 80 per cent of the fincas are smaller than 10 manzanas in size, and the rest are larger. The bulk of the land is in the hands of only a few families. This becomes clearly evident from an examination of the data in Table XXV.

TABLE XXV--SIZE OF COFFEE FINCAS, NUMBER OF PROPRIETORS, AND EXTENT OF HOLDING

SIZE OF FINCAS (manzanas)	PROPRIETORS		EXTENT OF HOLDING	
	NUMBER	% OF TOTAL	MANZANAS	% OF TOTAL
TOTAL	11,545	100.0	117, 215	100.0
Under 1	4, 801	41.6	2,841	2.4
1 - 10	4,967	43.0	19,294	16.5
11 - 50	1,322	11.5	32,156	27.4
51 - 100	263	2.3	19,194	16.4
Over 100	192	1.6	43,730	37.3

Source: F. Choussy, Economia Agricola Salvadoreña, San Salvador, 1950, p. 420.

The data in Table XXV are based on 1940 figures, but I believe the relation between the number of proprietors and the extent of

holdings, although slightly modified still serve to indicate the pattern of land ownership. Of the estimated 11,545 proprietors in 1940, about 15 per cent owned 81 per cent of all the land, while 41 per cent of them owned 2.4 per cent of the land. This ratio may change still more in favor of the 15 per cent who own over 81 per cent of the land if we consider that the table does not indicate that one proprietor may own more than one *finca* and that a number of *fincas* may be owned by one family. A large amount of the land is rented out to tenant farmers, particularly in the more remote areas to the north. In 1959, some 29,744 coffee producers were listed throughout the country, as compared to 12,000 proprietors.

A similar pattern of land ownership exists among the cotton producers. Over the last twenty years the number of cotton farmers has increased from 564 in 1940, to 3,677 in 1960. Aside from a few large *haciendas*, most of the cotton farms, or 87 per cent, are smaller than 100 *manzanas* (see Table XXVI).

TABLE XXVI--SIZE OF COTTON FARMS, NUMBER OF PRODUCERS, AND EXTENT OF HOLDINGS

SIZE OF FARMS (*manzanas*)	PRODUCERS		EXTENT OF HOLDINGS	
	NUMBER	% OF TOTAL	MANZANAS	% OF TOTAL
TOTAL	1,009	100.00	60,629.50	100.00
1 - 10	387	38.35	2,269.50	3.74
11 - 25	214	21.21	3,602.00	5.94
26 - 50	163	16.15	6,512.50	10.74
51 - 100	118	11.70	9,169.50	15.12
101 - 200	64	6.34	10,177.00	16.79
201 - 300	27	2.68	7,033.00	11.60
301 - 500	23	2.28	9,462.00	15.61
501 - 1,000	10	.99	6,404.00	10.56
1,000 - 3,000	3	.30	6,000.00	9.90

Source: El Salvador, Ministerio de Agricultura y Ganadería, *Informaciónes*, No. 78, San Salvador, 1959, p. 16.

Of the 3,677 cotton farmers licensed in 1961, only 1,009 are proprietors who own their land, while the rest are tenant farmers who lease the land for one season. Approximately 12.5 per cent of the proprietors own 64.5 per cent of the land, as compared with 59.5 per cent who own only 9.6 per cent of the land. As noted previously, these statistics unfortunately fail to indicate that one family may and very often does own a number of haciendas.

Farms

With few exceptions, the pattern of farm boundaries reflects the historic development of land occupance, which is closely related to the formal structure of the landscape. Small, irregularly-shaped holdings of the strongly dissected hills and mountain areas give way to large farm units in the lowlands, valleys, and coastal plains. Notable exceptions to this are the old ejidal lands surrounding villages and towns of the plains and lowlands. Here, small intensively used farms are common (see Figures 44 and 45).

I visited a number of fincas, haciendas, and granjas throughout eastern El Salvador, collecting information and data representative of each type of farming. It is interesting to note that there are few large agricultural undertakings restricted to one commodity only, with the exception of coffee and some large cotton farms. Generally two and sometimes three commodities will be represented. The following farms were chosen as being fairly representative of the four types of holdings.

Fig. 44.--Areal view of the Jucuarán Mountains. In center is the village of Intipucá. Note the extremely complex pattern of fields. This region is occupied by small <u>milpa</u> farms with some larger holdings in the more level valleys.

Fig. 45--Alluvial plains east of Usulután. Note the size and pattern of fields, which tend to be smaller closer to the settlements. On lower right is an old lava flow from the Volcán San Miguel.

A Coffee *Finca* in the San Miguel-Tecapa Mountains

Some 6 kms. north-west of San Miguel a paved road leaves the Pan American Highway and winds through the fields of sugar cane and sparsely covered lava flows along the northern slope of the Volcán San Miguel, toward the 900 meter-high saddle which links San Miguel with its smaller neighbor, the Volcán Chinameca. Perched half way up the eastern slope of Chinameca (see Figure 47) are a number of coffee *fincas* belonging to the Prieto family of San Miguel. Of these, the *finca* El Carmen can be considered fairly representative of the coffee region of eastern El Salvador (see Figure 46).

The owner, Don Carlos García Prieto, is a member of a well-known El Salvador family of Spanish descent. Don Carlos is a man with many interests, is widely travelled, and is familiar with affairs of state. Before he took over the management of the family *finca* some thirty years ago, he studied engineering in the United States. Like most coffee planters with large *fincas*, Don Carlos prefers to live in San Miguel rather than on the *finca*.

Late one night I had a call from Don Carlos, and we arranged to meet the next morning on the *finca*. On arrival I was greeted by the foreman, who had charge of the office. About an hour late, Don Carlos and his son arrived dressed for the occasion with *sombrero* and pistol. It was pointed out that most *finqueros* carry a gun when they go out into the country, for the workers regard this as a sign of authority.

The function of the *finca* is the production of coffee. Of the 136 *manzanas* (95 hectares), all except 5 *manzanas*, which are occupied by the workers' houses and the gardens and grounds of the *casa grande*, are occupied by coffee bushes. On a high slope overlooking the valley

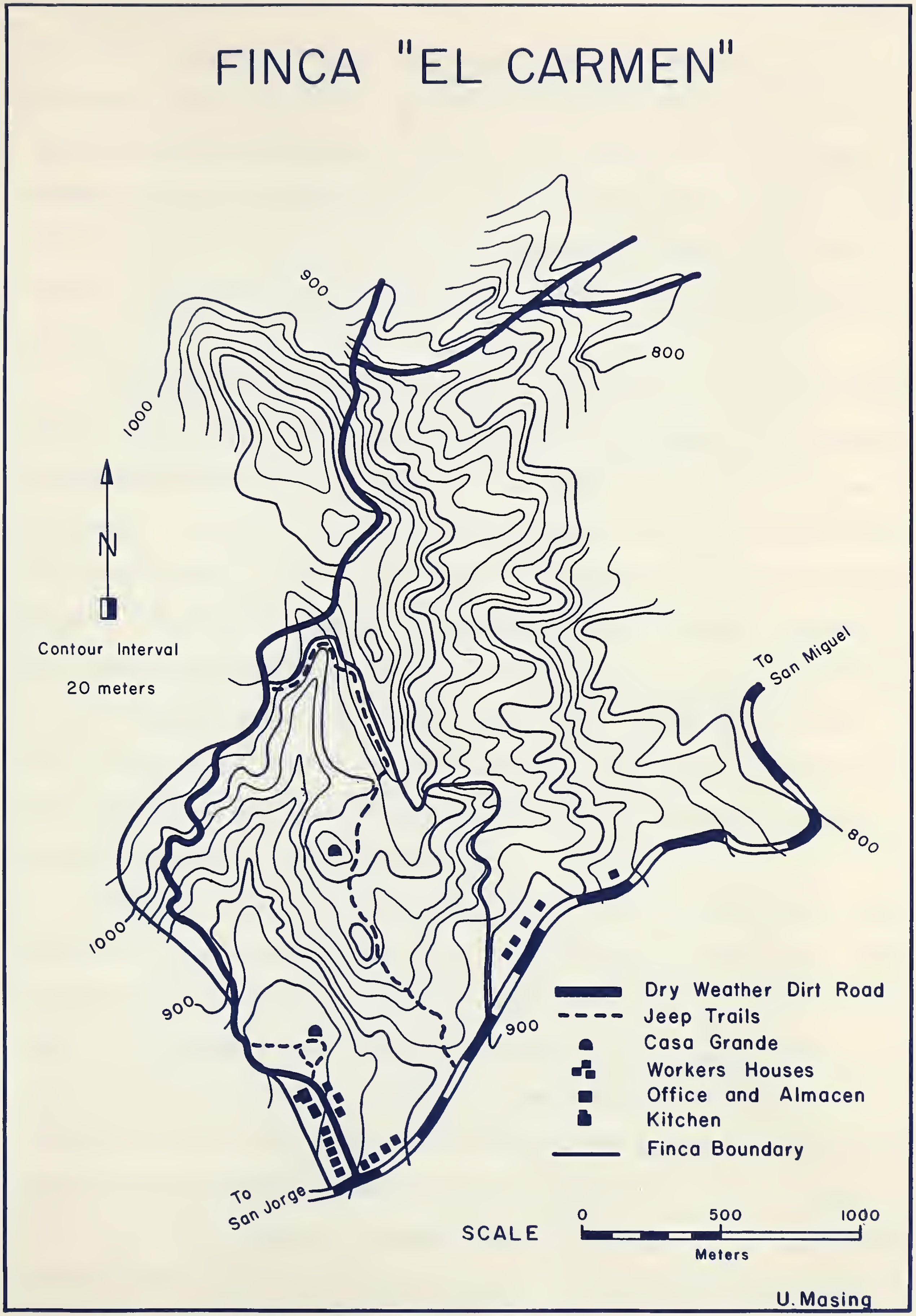
FINCA "EL CARMEN"
900
800
1000
N
Contour Interval
20 meters
To San Miguel
800
1000
900
900
To San Jorge
Dry Weather Dirt Road
Jeep Trails
Casa Grande
Workers Houses
Office and Almacen
Kitchen
Finca Boundary
SCALE
0
500
1000
Meters
U. Masing

Fig. 46

of the Río Grande de San Miguel is the _casa grande_, a beautiful large building of modern design with a touch of typical Spanish architecture. Equipped with all the modern conveniences of a luxurious life, the _casa grande_ is used as a summer or weekend home. Another modern building (see Figure 47) close to the main gate of the _finca_ is the home of Don Carlos' son who lives on the _finca_ and acts as _jefe_, or chief, during his father's absence.

There are about forty-eight workers of mixed blood living with their families permanently on the _finca_. Each family is provided with a comparatively comfortable small building with brick walls and a tiled roof (see Figure 48). Lacking a ceiling, the almost-square building is divided into four compartments of nearly equal size: two bedrooms, one living room and a kitchen. There is no glass in the windows because of the high cost, and once broken the worker cannot afford to replace it. Furniture consists of a cot or hammock, a few crude benches and a table. Illumination is by a dirty electric bulb hanging from the rafters. Although the owner has provided outhouse facilities, the people are slow to take advantage of them and seem to prefer the call of the wild.

With the exception of one or two isolated houses at the exits of the _finca_ where the women and children perform the duties of gate keeper, most of the houses are located on top of the saddle near the main entrance where the ground is level. Here also is the office, the _finca_ kitchen, and the warehouse where food supplies for the workers are stored. In contrast to some coffee _fincas_ in Guatemala and the _haciendas_ of the lowlands, the workers at El Carmen are not allocated land on which to plant their food crops. Instead the _finca_ provides the workers with the standard peasant diet of tortillas and black beans. The food is prepared at the _finca_ kitchen (see Figure 49) and is either eaten in the communal dining

[illegible]

Fig. 47.--The second <u>casa grande</u> which belongs to the son of Don Carlos, is located on top of the saddle near the main entrance.

Fig. 48.--Each family on <u>Finca</u> El Carmen is provided with a comparatively comfortable small building.

Fig. 49.--The _finca_ kitchen provides the workers with the standard peasant diet of _tortillas_ and black beans. To the left of the stove there are three _metates_ or grinding stones, where the corn is ground by hand.

room or taken home to be eaten. On one of their neighboring farms the Prietos have a commissary where the workers may buy most of the basic things they need. Until recently workers were allowed to buy on credit, the amount spent being deducted from their weekly pay; however, the new military government in power since February, 1961, has prohibited the extention of credit to the workers. Aside from a commissary, the workers are provided with free medical treatment and a six year elementary school. The Prietos provide the building and pay the salaries of the teacher and physician as a voluntary benefit to the workers.

The quality of coffee varies with elevation and the yield with soil and rainfall. _Finca_ El Carmen is situated on the east slope of the Volcán Chinameca at elevations of 800 to 1,100 ms., a belt which produces very high quality coffee. Most of the _finca_ land is in relatively steep slope (see Figure 50) and provides the rapid runoff needed for coffee cultivation.

Coffee requires rich soil; repeated volcanic eruptions have kept the soils replenished through the ages and the rains have contributed to the fertility by washing new soil down from the higher peaks. Don Carlos related an anecdote often told among the coffee growers of the Central Americas, concerning a _finquero_ whose _finca_ was buried by volcanic eruption. When he returned to his land years later, he discovered to his surprise that the calamity had turned out to be his greatest fortune, for the new soil formed from the volcanic materials was very rich.

The soils of El Carmen are slightly acid and moist, and belong to the group of brown soils of the dry forests, rich in humus in the upper 'A' horizon, which may attain a depth of 13 cms. or more. The soils are fine-textured clays, slightly sandy in places. Due to their fine texture

they possess very good water storage capacity throughout the year, particularly during the long dry season. The drier areas are on the steep slopes with very rapid surface drainage and exposed to desiccating effects of the winds.

To protect the coffee trees from the effects of direct exposure to the sun, coffee is grown beneath shade trees. Among the more common shade trees are the madrecacao (Gliricidia sepium), which provides good shade due to its large leaves, and the popular pepeto del rio (Inga sp.), with smaller, thinner, and more translucent leaves.

Finca El Carmen grows arábigo coffee exclusively. To keep the finca in good condition, forty-eight workers are retained as a permanent labor force throughout the year. Weeds are cut at least twice a year, always immediately before and after picking, and the plants are pruned to restrain unnecessary new growth. Some parts of the farm are being renewed by cutting the eight-year-old trees just above the ground and letting new shoots grow. In other parts new trees are planted to replace older ones (see Figure 51). Up to now the advantages of one system over the other are not apparent since this is the first year it has been tried. New plantings follow the contour line to retard erosion which is a constant problem, particularly on the steeper slopes. In order to reduce the effects of the runoff, Don Carlos follows the practice of all coffee farmers -- that of building stone walls across the runoff channels and planting rows of izote (Yucca elephantipes) along the slopes (see Figure 50). These lines of izote are locally referred to as cortinas, or curtains.

In addition to these protective measures, each individual new tree planted on the contour line is located on a 2-meter-wide terrace. A hole is excavated in the terrace between the plant and the slope,

Fig. 50.--A network of well constructed and maintained dirt roads traverses the _finca_ in an irregular pattern. Note the rows of _izote_ along the road cut for erosion control.

Fig. 51.--Young coffee trees are bent to the side to permit the growth of new sprouts and thus the formation of a bush rather than a tree.

to be used for fertilizing and storing runoff. Once or twice a year the trees are fertilized; the most common fertilizer of German manufacture contains 13 per cent nitrogen, 13 per cent phosphoric acid, and 20 per cent potash.

A good tree will yield as much as 50 to 60 pounds of berries annually, depending on the age of the tree and on the soil. There are good years as well as bad years, for no known reason. Occasionally trees that have borne abundantly for several seasons take a rest. The weather can have a deciding influence on the crop. Excessive rain prevents pollination and may damage the blossoms before the young coffee fruit is set. Winds strong enough to break the branches may also reduce the crop considerably.

During the harvest season, which lasts five to eight weeks, during September and October, the permanent labor force is increased from forty-eight to three hundred by migratory workers, and by the wives and children of the permanent workers. Coffee is picked according to the color of the berry and care is taken to pick only the ripe berries. During this time everybody works, for the success of the crop and wealth of the planter depend on the _mestizo_, the poor, illiterate, usually humble _colono_, who earns about ₡1.50 (62 cents) a day. A few good pickers may pick as much as 400 lbs. of berries a day and receive .80 _colones_ for one bag, which weighs about 80 to 90 lbs.. During harvest time everyone on the _finca_, including the women and children, works. The women earn about .60 _colones_ (25 cents), and the children about .40 _colones_ (16½ cents).

A number of well constructed and maintained dirt roads (see Figure 50) and trails traverse the _finca_ in an irregular pattern and provide easy access to all parts. Through time some of these roads have

become entrenched deeply in the earth, reaching depths of 3 to 10 ms. below the general surface in places (see Figure 72).

The daily harvest is transported by truck from the _finca_ directly to the _beneficio_ at Chinameca, where the coffee is sorted, fermented, washed, dried, and sacked for export. The _beneficio_ belongs to Don Carlos and processes much of the coffee from neighboring _fincas_ of the Volcan San Miguel and Chinameca area.

An _Hacienda_ in the Rio Grande de San Miguel Lowlands

Approximately 9 kms. south of San Miguel the road connecting the Pan American Highway with the new coastal highway leads through the _hacienda_ El Delirio (see Figure 52). The _hacienda_ is the property of Don Rene Garcia Prieto and his brother Federico. Don Rene, who manages the property, is a man with progressive ideas and proud of his land. Both he and his brother prefer to live in San Miguel where Don Rene has a modern air-conditioned _villa_ on the outskirts of the city, surrounded by ornamental bushes and fruit trees.

El Delirio is situated in the valley of the Rio Grande de San Miguel and embraces part of the Desague Madre, an outlet of the intermittant Laguna de San Juan, about 3 kms. west of the _hacienda_. During the rainy season when the water level of the lake rises, it drains through the Desague Madre into the Rio Grande.

The land of the _hacienda_ is of two types: (1) a flat alluvial plain (see Figure 53), some 50 to 60 ms. above sea level, and (2) strongly dissected erosional remnants of volcanic origin (see Figure 54) with steep slopes and isolated elevations of up to 190 ms.. Of the _hacienda's_ 2,850 _manzanas_, approximately half are level land with less than 2 per cent

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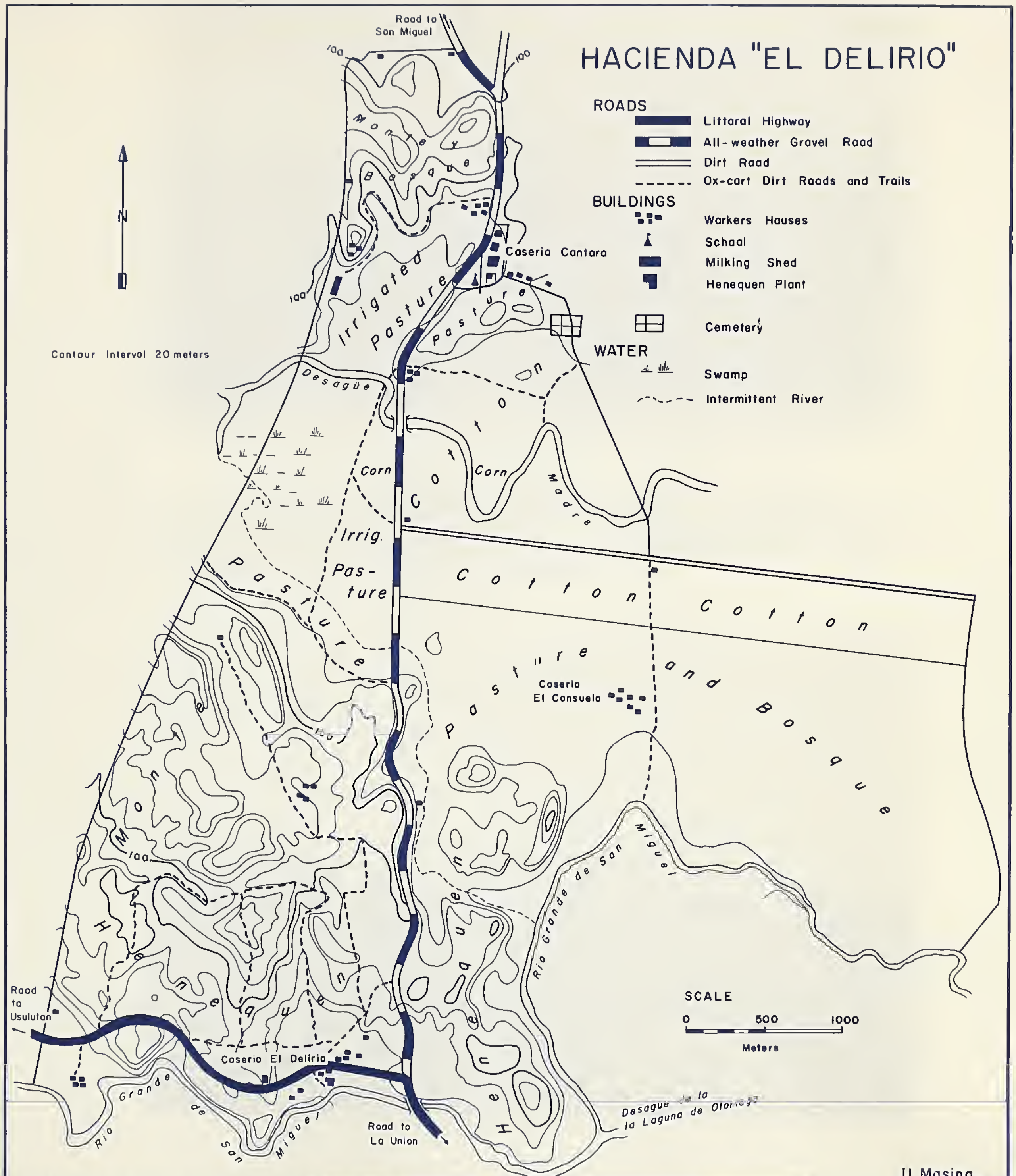
HACIENDA "EL DELIRIO"
ROADS
Littaral Highway
All-weather Gravel Raad
Dirt Raad
Ox-cart Dirt Raads and Trails
BUILDINGS
Warkers Hauses
Schaal
Milking Shed
Henequen Plant
Cemetery
WATER
Swamp
Intermittent River
Contour Intervol 20 meters
SCALE
0 500 1000
Meters
Road to San Miguel
Monte y Bosque
Irrigated Pasture
Pasture
Caseria Cantara
Desagüe
Cotton
Corn
Corn
Madre
Irrig. Pas-ture
Pasture
Cotton
Cotton
Pasture
Caserio El Consuelo
and Bosque
Monte
Henequen
Henequen
Rio Grande de San Miguel
Road to Usulutan
Caserio El Delirio
Rio Grande de San Miguel
Road to La Union
Desague de la la Laguna de Olomega
U. Masing

Fig. 52

Fig. 53.--Hacienda El Delirio. The flat alluvial plain is used for the production of cotton. Don René Prieto in foreground initiating survey for an irrigation project. Volcán San Miguel in the background.

Fig. 54.--Hacienda El Delirio. The strongly dissected erosional remnants are used for the production of henequen. Caserío El Delirio located in the center of the picture. In the background are the Jucuarán mountains (C_1).

slope and potentially cultivable. The remainder is in slope ranging from 10 per cent to 75 per cent, too steep for mechanized agriculture. The alluvial plain is covered with deep, dark colored clayey soils, somewhat sandy in places and sticky when wet (see Figure 53). Drainage is generally poor but good in the higher places. During the rainy season most of the plain is periodically flooded. This restricts the use of heavy agricultural machinery to the higher, better drained parts of the plain and makes cultivation possible only during the dry season and the early part of the rainy season when rainfall is not too heavy. The erosional remnants that make up the southern part of the hacienda are underlain by lightly cemented, dark colored lavas. The lower, gentle slopes and rounded hillocks are mantled with relatively shallow, reddish clay soils which tend to become increasingly shallow and rocky on the steeper slopes and high peaks.

The hacienda is quite diversified in its agricultural production (see Table XXVII) which has been closely related to the slope, drainage, and the soils of the land. Approximately one-third of the land is occupied by commercial crops, cotton on the higher and better drained parts of the alluvial plain (see Figure 53) and henequen on the slopes and hillocks (see Figure 54) with infertile and excessively drained soils. About 720 manzanas are in pastos sembrados, or cultivated pasture land, and occupy the poorly drained, moist areas of the lowland. Of the remainder, 1,030 manzanas are in montañas altas (rough hills), and montes y bosques (brush and scrub), 160 manzanas are alotted to the workers for the production of food crops, and approximately 120 manzanas are taken up by roads, building sites, and rivers.

Cotton is not the major crop in terms of area, but it provides the bulk of the farm income. The success of the crop depends to a large

degree on the preparation of the soil. During the last part of the dry season or early rainy season, the branches of the cotton plants from the previous harvest are cut off above the ground, piled into heaps, and are burned. The material is then plowed under with disc-plows to a depth of approximately 30 cms. and harrowed once or twice to level the surface and to secure a uniform germination of the young plants and distribution of moisture. Seeding takes place during the short break in the rainy season between July and August, and is done by hand because by that time the fields are too wet to permit the use of machinery. Approximately 25 kgs. of seed are sown per hectare, with the individual furroughs running approximately 1 m. apart. When the young plants have reached about 20 cms. in height, they are thinned out, leaving one plant every 25 cms.. This gives an approximate density of 43,500 plants per hectare.

TABLE XXVII--*HACIENDA* EL DELIRIO, LAND USE IN 1961

(in *manzanas*)

USE TYPE	AREA
Cotton	320
Henequen	500
Alotted to workers	160
Pastos sembrados:	
Pangóla	500
Pará	220
Jaraguá	300[a]
Montañas altas (grasses only)	270
Montes y bosques	760
Roads, buildings, rivers, and swamps	120
Total area of *hacienda*	2,850

[a] The *jaraguá* is interplanted with *henequen*.

Source: Based on information obtained in the field.

Government controlled production has introduced a single type of cotton throughout the country -- the Delta Pine - 15 -- a United States upland variety with a staple length of 1 1/32 to 1 3/32 ins., well-adapted to the climate of the country.

Climatic conditions of the lowlands are ideal for the growth of cotton. Rainfall is of the convectional thunder-shower type. The black alluvial clay soils are fertile and need little fertilizer to produce a good crop. They possess a good water storage capacity and will retain much of their moisture throughout the dry season. Cotton roots penetrate deeply into the ground and thus, during the dry season, the cotton not only matures, but continues growing by tapping the stored soil moisture.

The output per <u>manzana</u> averages up to 45 quintals. With irrigation this can be doubled. The owner is at present preparing an elaborate drainage and irrigation system to regulate the supply of moisture throughout the year. At present only 220 <u>manzanas</u> of lowland pasture and a small amount of cotton are being irrigated on an experimental basis.

From December to April cotton is picked once a month by hand. By that time the soil is dry enough to support heavy agricultural machinery but the owner believes that due to the readily available ground water, the plants will continue to grow and produce throughout the dry season. If picking is done by machines, the plants are broken and only one crop can be harvested. The cotton is taken by truck from the fields directly to the <u>beneficio</u>, or cotton gin, El Papalón, approximately 6 kms southeast of San Miguel. The gin belongs to the Cooperativa Algodonera Salvadoreña, a Government agency in charge of distribution and processing of cotton. An important aspect of the cooperative and an important part

of cotton production is the application of pest controls, which is provided to all cotton growers.

Henequen, which provides the second largest income, is cultivated on the slopes and hills of the southern part of the hacienda, an area with excessive drainage, poor water storage capacity, and relatively shallow reddish clay soils of volcanic origin. In places the soils are rocky and infertile, which makes them of little value for other crops.

The 500 manzanas which are at present under henequen cultivation are divided into parcelas, or fields, separated by callejones, narrow dirt roads that converge on the henequen beneficio located south of the littoral highway beside the Rio Grande de San Miguel. In 1961, only 358 manzanas were under production, with another 142 manzanas coming into production by the end of 1962. Every year new land is cleared and planted to henequen, gradually increasing the production of the hacienda. At the end of the rainy season the new land is cleared and left to dry until the end of the dry season, when it is burned. If slope conditions permit, the land can be cultivated prior to planting. However, if slopes are too steep and dissected, no soil preparation is carried out. With the first rains, the hijos, or small henequen plants that have been cut from the base of adult plants and kept in nurseries from one to two years, are planted in the new clearing in rows, with approximately 1.25 ms. between each plant, and 3 ms. between rows (see Figure 55).

The quality of the henequen fiber varies with the soil. On tierra blanca, a white soil of volcanic origin, the plants are small but produce good fibers and may stay in production for close to thirty years. On red clay soils the life span is somewhat shorter, ranging from fifteen to twenty years, but the fiber is good. On black, fertile

Fig. 55.--Hacienda San Andres. The young henequen plants are planted in rows approximately 1.25 ms. between each plant.

Fig. 56.--The wet henequen fibers are transported to the drying yard where they are left to bleach in the sun.

soils, plants grow quickly and attain greater height, but the leaves are water-logged and the life span of the plant does not exceed seven to ten years.

After the young plants have been planted, they are left to themselves for a period of six to ten years, with a minimum amount of care. Depending on the soil and moisture conditions, many of the leaves will by that time have attained a length of over 80 cms. and be ready for harvest. During this unproductive stage when plants are said to be in _cultivo_, two and sometimes three _limpias_, or clearing of weeds, are necessary per year to keep the undergrowth from choking the young plants. In some plantations this is done with tractors, but the land of El Delirio does not lend itself to the use of machinery due to the steepness of slope. The worker cleans out the area around the plant with a _cuma_, a _machete_ with a curved blade at the end. When the plants are mature and in full production one _limpia_ per year usually suffices to keep the weeds down. On some _haciendas_ the _colonos_ are permitted to plant beans and corn between the rows of _henequen_, but Don Prieto has set aside some land for this purpose and has interplanted 300 _manzanas_ of _henequen_ with _jaraguá_ grass to prevent erosion and the spread of fungus disease among the plants.

After the _henequen_ has reached maturity the plants produce three to five harvests a year for ten to twenty years, after which time production declines, and the plants have outlived their usefulness. On _Hacienda_ El Delirio, _henequen_ is harvested four times a year. A well-developed plant yields from eighteen to thirty-five leaves per year, varying in length from 80 cms. to 1 m., and 10 to 15 cms. in width. The number of leaves and the length depend on the number of previous cuttings, as well as on soil and moisture conditions. All of the lower

leaves that have matured and bend towards the ground at an angle of 45 degrees or less are cut, cleaned of their spines, and arranged into bundles of twenty-five to fifty leaves, depending on leaf size. The cutter then carries the bundles to the nearest callejon, where they are picked up and taken to the beneficio. A good worker will cut and bundle between five hundred and one thousand leaves a day, for which he receives C1.50 (60 cents). Sometimes three colonos will work together as a team, one doing the cutting, one the bundling, and the third the carrying.

The bundles are transported from the fields to the henequen beneficio by ox cart. The oxen and the cart are usually the property of the driver who gets a special allowance for his oxen. At the beneficio they are stacked and await processing. A henequen leaf contains approximately 90 per cent water, 7 per cent dry pulp, and 3 per cent fiber, by weight.

Henequen is a very hardy plant and has few diseases. The most serious is the mancha negra, a black fungus (Diplodia natalensis) which stains the leaves black and ruins the fiber. Because the fungus spreads very little during the dry season and rapidly during the rainy season, all plants should be carefully inspected during the rainy season and the defective leaves removed. This eliminates the danger of the disease almost completely. Jaraguá grass is said also to help prevent the spread of the fungus.

Cost of production varies from hacienda to hacienda and even within the hacienda itself, depending on the land, vegetative cover, road conditions, modes of transport, and the number of limpias required per year. On the average the cost per manzana is as follows:

Preparation of land	₡15 - 25	($6 - 10)
Planting	₡20	($8)
<u>Limpia</u> (twice a year)	₡15 - 25	($6 - 10)
Harvest and transport	₡40 - 45	($16 - 18) per year.

Considering the average yearly production to be around one thousand pounds of first class fiber, the cost of production from clearing of the land to delivery to the <u>beneficio</u>, not considering maintenance costs, administration, medical care for workers, and taxes, would be roughly .08 <u>centavos</u> (3 cents) per pound.

The <u>beneficio</u> where the fibers are extracted from the leaves uses large quantities of water and is therefore located close to the Río Grande de San Miguel. Otherwise, the plant could be more centrally located within the plantation and thus reduce the cost of transportation. The building has a shed-like appearance and is open-walled to permit the passage of air and light. The fibers are extracted from the leaves by mechanical decortication. All decorticating machines function on the same principle. The one at the <u>beneficio</u> El Delirio is a German Krupp-made unit about forty years old, but in excellent working condition. Some six to eight workers, mostly women, sort out the diseased leaves and place the individual healthy leaves side by side on a conveyor which consists of two chains. The leaves then pass sideways through two rotating laminated cylinders where the pulp is squeezed and washed out. At the other end of the cylinders the wet fibers are collected and transported in wheelbarrows to the drying yard, where the wet fibers are hung over long lines of wire to dry and bleach in the sun (see Figure 56). After two or three hours they are almost completely dry. From there they are carried by women and children to the warehouse, where they are pressed into bales and transported by truck to the nearest

factory or export harbor. The beneficio employs approximately forty people, half of whom are women. The number is not permanent since the plant does not operate throughout the year. Those considered skilled workers, such as machine operators, mechanics, and office personel, receive higher wages of ₡3.75 ($1.50) and ₡4.00 ($1.60) per day, as compared to the unskilled workers who receive ₡1.50 (.62 cents) to ₡2.00 (.80 cents) per day.

Compared to cotton and henequen, livestock plays only a minor part in the economy of the hacienda. At present there are 165 milk cows, two pedigreed bulls -- a brown Swiss (see Figure 57) and a zebu -- and approximately fifteen calves. The dairy cattle are a cross-breed of brown Swiss and zebu, with the native criollo, and thus combine an immunity to tick fever with good milking qualities. At present milk production averages approximately one-thousand kilograms per day with a butter-fat content of 4.2 per cent to 4.6 per cent. The amount of milk production varies from dry season, 850 kgs., to rainy season, 1,250 kgs.. Milking is done twice a day by hand due to lack of well-trained personnel and insufficient power for electric milkers. Until two years ago milk production was unprofitable, but with the formation of a co-operative and the building of a modern milk plant just outside of San Miguel, production is becoming more profitable and is at present paying for itself. Aside from dairy cattle there is also a herd of approximately three hundred head of beef cattle, a cross between criollo and zebu (see Figure 30). The owner is trying to increase the present herd to approximately four thousand head over the next few years.

In order to maintain the livestock throughout the year, 1,020 manzanas have been planted to pasture (see Figure 58). Of these, 500 manzanas are planted to pangóla grass (Digitario decumbenes), 220

Fig. 57.--Hacienda El Delirio. Pedigreed brown Swiss bull.

Fig. 58.--Numerous shade trees, particularly the carreto, are left in the pastures. Aside from providing shade these trees produce a fruit which is relished by the animals and adds a fine flavor to the milk.

manzanas to pará (Panicum barbinode) and 300 manzanas to jaraguá (Hyparrchuria rufa). At this time only 150 manzanas are being irrigated during the dry season, to provide for the dairy cattle. However, the owner plans to increase the area under irrigation to include all of the lowlands, by 1963.

Pangola, which is considered to be one of the best pasture grasses, is an introduction from Africa. The grass prefers soils that possess good water storage capacity, and remain humid throughout the year. The pangola will produce well, even over prolonged periods of drought when protected from direct rays of the sun. For this purpose, numerous trees, particularly the carreto (Pithecolobium saman) are left as shade trees in the pasture. Aside from shade, these trees have a fruit which is relished by the animals and which adds a fine flavor to the milk.

Similar to the pangóla is the pará which will grow only if sufficient moisture is available. The jaraguá on the other hand, is a grass that will reach heights of up to 2.5 ms. if left undisturbed, and prefers dry, stony surfaces where other grasses will not grow. If kept short, the jaraguá makes a good pasture particularly in dry areas, throughout the year.

Approximately 1,030 manzanas are classed as montañas altas and montes y bosques, and are used as unimproved pasture land for the beef cattle. In time the owner plans to seed most of the area to pasture, particularly to jaraguá, which is well-adapted to the dry, stony slopes.

The total number of people employed on the hacienda varies throughout the year, but is probably somewhere around three-hundred fifty. Each worker is provided with a small plot of land, the size of which may vary with the need and size of the individual family, but generally does not exceed 1 manzana. On this small plot or terreno

the _colono_ will grow the corn and beans he needs to maintain his family. In return for the use of the land he is expected to work for the _patrón_, either a certain number of days each month, or a certain number of months each year. For this work he is paid the going wage of ₡1.50 to ₡2.00. Aside from the _terreno_ he is granted a "house" or _rancho_ for him and his family. In some cases he builds his own.

The quality and type of abode varies greatly among individual _haciendas_ and _fincas_ (see Figures 59 and 60), as well as with climatic conditions. In the hot lowlands the walls are generally made of small vertical poles with thatched roofs. In the cooler uplands the houses are of the wattle and mud type constructuion, and have a very nice appearance when plastered over and whitewashed. The rough, red tiles, introduced by the early Spaniards are more common in the cooler, wetter areas and are sometimes used with thatch. Most of the houses are simple one-room structures with hard dirt floors and open fire places.

During the past decade greater efforts have been made to provide the _colonos_ with better living conditions. On many of the large _haciendas_ and _fincas_ two to three-room brick buildings are replacing the old one-room _ranchos_. However, with few exceptions, such services as running water, light, and toilets are completely lacking. One large _hacienda_ west of San Miguel provided one three-quarter inch water pipe with one outlet for a community of two-hundred fifty people. More often the _colono_ and his wife and children have to walk several kilometers to the nearest river to bathe, do the laundry, and carry drinking water home. The same is true of firewood. Although the _colono_ is allowed to cut wood on the owner's property he usually has to walk long distances to bring home a supply.

As a rule, the houses are grouped into aggregates known as

Fig. 59.--The quality and type of abode granted to the workers varies greatly between individual _fincas_ and _haciendas_ and with climatic conditions.

Fig. 60.--As a rule the houses are grouped into aggregates known as _caseríos_ or _cantónes_, the size of which may vary with the individual _finca_ or _hacienda_. The above is a _caserio_ in the interior of eastern El Salvador. These houses are considered good by local standards. Note lack of windows.

caseríos or _cantónes_, the size of which may vary from a few scattered dwellings to a well-ordered small village community of more than one hundred people. On the _hacienda_ El Delirio there are four _caseríos_ and a number of isolated dwellings located near the entrances to the individual fields where the occupants have the additional responsibility of guarding the gates. The largest of the _caseríos_, the Caserío Cantora, provides the inhabitants in addition to land and dwellings, with a chapel, a school, a commissary and free medical treatment. The owner's brother, Dr. Prieto, visits the _caseríos_ once a week to administer to the needy. Formerly the teachers were paid by the owner but in recent years the Government has assumed this responsibility. Thus the _colono_ plays a dual role in the agricultural economy. Primarily he is a worker, but at the same time he is a small independent farmer and is classed as such by the census bureau.

A Sample Cantón and Granja

Cantón

A _cantón_ is a section of a _municipio_. Generally a _municipio_ is divided into a number of _cantónes_ or administrative units. To confuse the matter the term is also applied as a synonym for _caserío_ or _aldea_, which are compact rural communities. The _cantón_ in this context does not refer to a type of settlement but to a section of a _municipio_ (see Figure 61).

Cantón Llano del Angel has been selected because it is representative of a system of farming and land holding that is prevalent throughout the larger part of eastern El Salvador, particularly the Northern Mountains (E), the Jucuarán Mountains (C_1), and parts of the hill land

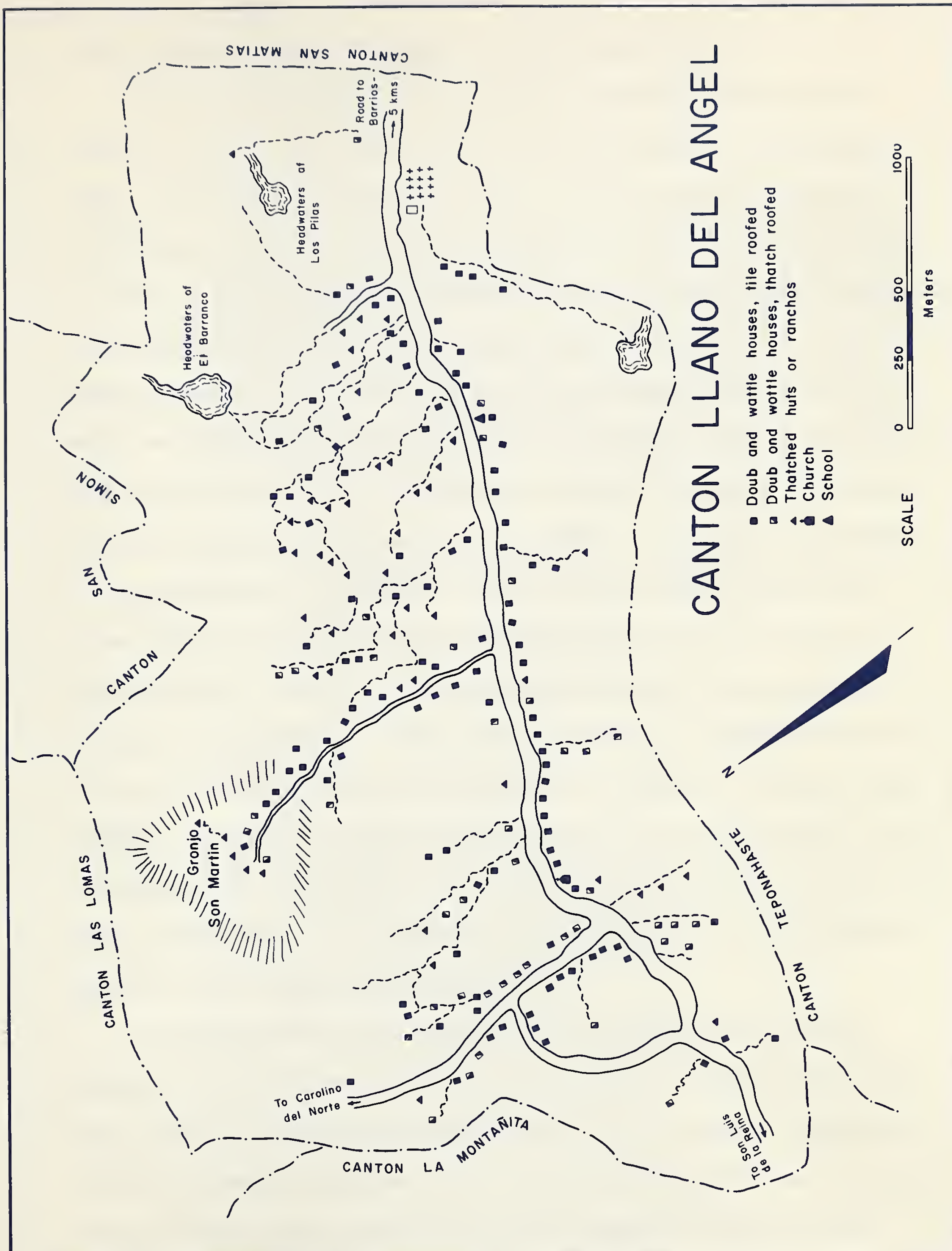
CANTON LLANO DEL ANGEL
Daub and wattle houses, tile roofed
Daub and wattle houses, thatch roofed
Thatched huts or ranchos
Church
School
SCALE
0 250 500 1000
Meters
N
CANTON SAN MATIAS
Road to Barrios- 5 kms
Headwaters of Los Pilas
Headwaters of El Barranco
CANTON SAN SIMON
CANTON LAS LOMAS
Granja San Martin
To Carolina del Norte
CANTON LA MONTAÑITA
To San Luis de la Reina
CANTON TEPONAHASTE

Fig. 61

(D_4) where slopes are too steep to be plowed and the _macana_ (planting stick) and the _machete_ are the basic agricultural tools.

Physiographically this is a region of mature to late mature erosion on the western flank of the volcanic uplands of the Cacaguatique. Slope varies from 5 to 75 per cent with steeper slopes predominating. Numerous small streams thread through the region and have cut deep valleys separated by relatively narrow divides (see Figure 62). The principal soils are deeply weathered and leached reddish brown humic latosols, rich in clay and with good drainage. Among the best soils are the colluvial-alluvial soils at the lower bases of the slopes. Rock outcrops were not in evidence but stoniness is common throughout, rendering many of the steeper slopes useless to intensive cultivation. The comparatively high amount of organic matter which forms under a forest cover decomposes rapidly and washes away once the forest has been destroyed. Like most of El Salvador's soils, they are low in nitrogen and phosphorus. Since fertilizers are not used the fertility of the soil is replenished by permitting the regrowth of natural vegetation. The amount of plant food deposited in the upper layers of the soil depends on the length of time the natural vegetation is allowed to remain undisturbed. Thus the soil rest period is the most important element in this _milpa_ type of agriculture.

Situated on the hilly uplands of the strongly eroded Volcán Cacaguatique (see Figure 62) some 4 kms. north of Ciudad Barrios, the _cantón_ covers an area of approximately 10 to 12 sq. kms.. Despite a relatively dense population only few houses are visible from the main road to Carolina which leads through the _cantón_ from east to west. The houses are scattered throughout the _cantón_ 50 to 100 ms. apart and are hidden from view by a dense growth of trees and brush (see Figure 63).

Fig. 62.--Canton Llano del Angel, view east to the Volcan Cacaguatique. The canton is situated on the strongly eroded hilly uplands, approximately four kilometers north of Ciudad Barrios.

Fig. 63.--Numerous trails wind through the canton. Note the effects of erosion and the large exposed boulders, probably of volcanic origin.

Because heavy rains had made parts of the exit roads from the town completely impassable, I was unable to drive by car to Canton Llano del Angel from Ciudad Barrios. The alcalde, or mayor and law enforcement officer, of Barrios arranged for horses and a guide to take me to the canton where I was to meet the comisionado, the appointed law enforcement officer. With his help I was able to spend the day visiting numerous small land owners and their families and observe and discuss their daily lives.

Leaving the main road a trail winds through the forest and up a gentle slope for some 200 ms., at the end of which is the house of the comisionado. Sr. Perez is typical of the two-thirds of the 1,042 people living in the canton. He does not own any land, not even the tiny three-cornered plot of rock-strewn slope (see Figure 64) just large enough to accommodate his one-room, dirt-floored, thatch-covered rancho.

In order to feed his family of eight, he needs 35 to 40 quintals of corn per year, but without the use of fertilizer which he cannot afford, the one manzana of rented milpa will only yield 15 quintals, and if the year is exceptionally good, 16 quintals. For the use of the land which is 4 kms. from his house, he pays the yearly sum of C32.50. To secure the additional corn to feed his family, Sr. Perez plants a crop of maicillo after the corn harvest. Maicillo, which is more drought-resistant, will yield a reasonable crop during the dry season. With the maicillo he fattens one or two small pigs which are sold on the market in Ciudad Barrios. For this money he can then afford to purchase the additional corn and a few luxury items such as cigarettes, a new shirt, and perhaps a new dress for his wife.

Some 100 ms. further up the slope is a small square-shaped plot,

approximately 20 by 30 ms., on which stand two small ranchos (see Figure 65), hidden behind a dense growth of coffee trees and badly in need of repair. The owner, Señora Sanches, an Indian woman who believes she is eighty-five years old, is typical of a large number of small land owners. Half of the plot is covered by a dense thicket of coffee trees too closely spaced, too heavily shaded, seldom pruned, and the other half is occupied by the two ranchos and two small open sheds used for storage and as a pig sty and apiary. Aside from the small lot the family owns 1 manzana of slope land and rents an additional manzana from a local land lord; both are used for milpas. As in all other cases, the houses are located on the more level land while the milpas are some distance from the scattered settlements and occupy the steeper slopes. From the 2 manzanas the family is able to harvest enough to fatten a few pigs, sell some corn, and live comparatively well by the standards of rural El Salvador. In addition to corn and maicillo it is a common practice to plant rice, some beans and some yuca in-between the corn to supplement the diet.

Granja

Occupying the highest hill overlooking the canton is the granja San Martin. The granja is a typical example of the comparatively few independent small scale farmers (see Figure 61). The owner, a man in his late fifties and the father of eleven children is of Indian descent. He inherited the granja from his father and believes that it has been in the family for a long time. In 1961, the land use of the granja was as follows:

Fig. 64.--The rancho of the comisionado. His wife and three of their seven children. The walls are made of sticks stood on end, interwoven with banana leaves. The roof is made from rice straw. Note the large boulders, common throughout the volcanic uplands.

Fig. 65.--Hidden in the dense growth are numerous small ranchos such as this. Note the banana plants in the foreground. Many of these properties have stone walls similar to those of New England. The walls of the houses are made from sticks woven into a frame which is then covered with clay.

TABLE XXVIII --LAND USE ON *GRANJA* SAN MARTIN IN 1961

LAND USE	MANZANAS
Farmstead, *trapiche*, vegetable garden. (pineapples, *yuca*, etc.)	1.5
Coffee	5.0
Sugar Cane	3.5
Corn and beans	2.0
Rice	2.0
Leased	16.0
Unimproved pasture and second growth	33.5
TOTAL	63.5

Source: Based on field observation and interview.

Aside from the 63.5 *manzanas* the owner leases another 60 *manzanas*. The *granja* counts forty head of cattle, five oxen, two horses, half a dozen pigs, and a number of chickens and turkeys. Most of the land is in slope. The upper parts are used for pasture land and covered in part by *restrojo*, while the lower, more gentle slopes on the north, which can be worked with a plow, are given over to the annual crops of corn, beans, and rice. Coffee occupied the land surrounding the house while the sugar cane bordered the annual crops on the more gentle, well drained slopes.

Much of the year the owner manages without help, but during the harvest season he employs eight full-time workers at ₡2.00 per day without meals. By the middle of November, rice is harvested followed immediately by corn. Rice and corn are both transported on horseback to the main building where they are stored in the attic in empty oil drums to keep the rats away.

Coffee provides a part of the farm income. In 1960/61, the harvest amounted to 65 quintals in berries, all of which was sold. The major income of the *granja* is from the manufacture and sale of

panela. Sugar cane is cut with machetes and transported by oxen to the trapiche where the juice is expressed. The trapiche is powered by oxen (see Figures 66 and 67). The juice is then boiled, evaporated, and poured into wooden molds shaped like four-inch flower pots. After cooling, the cakes are wrapped in corn husks and tied in bundles of two; they are then taken to the local market at Ciudad Barrios. Additional income is derived from cheese, also manufactured on the granja and sold in Barrios. The owner, who is illiterate, was not able to give account of the individual income from each commodity but believes that his net income from all land is approximately ₡2,000 per year ($800).

Most agricultural units in the mountainous regions, with the exception of some coffee fincas, are small compared to the haciendas of the coastal plains and the interior lowlands. Living conditions are extremely primitive and contacts with the outside world are few and infrequent due to lack of adequate transportation facilities. Electric light and running water as well as outhouses are virtually unknown to most people with the exception of those in larger towns.

Central Places and Centralized Services

The location of service centers throughout eastern El Salvador is closely related to the uneven distribution of the rural population, existing road conditions, land use practices, and physical characteristics of the area. Thus the pattern that emerges throughout the northern mountains differs markedly from that of the coastal plains and interior lowlands and from the Jucuarán Coastal Mountains.

Prior to any discussion of service centers and services, the

Fig. 66.--A primitive trapiche, or sugar cane press, powered by a team of oxen, common throughout eastern El Salvador.

Fig. 67.--The juice is transported from the trapiche, to the right in the picture, by a three-quarter inch tube to the boiler room where it is boiled, evaporated, poured into wooden molds, and left to cool.

following facts regarding the distribution of the population and their classification should be understood. The rural population in eastern El Salvador is 73.6 per cent, approximately 13.5 per cent higher than the rural population of the nation as a whole. The distribution and percentage of rural population for the four departamentos according to estimates for 1959,[2] are as follows:

TABLE XXIX--DISTRIBUTION OF URBAN AND RURAL POPULATION OF EASTERN EL SALVADOR IN 1959

DEPARTAMENTOS	POPULATION TOTAL	URBAN	%	RURAL	%
San Miguel	232,386	72,227	31.0	160,159	69.0
Usulután	216,988	65,088	30.0	151,900	70.0
La Unión	156,542	35,386	23.0	121,156	77.0
Morazán	130,750	22,325	17.0	108,425	83.0
TOTAL POPULATION	736,666	195,026	26.4	541,640	73.6

Source: El Salvador, Ministerio de Economía, Boletín Estadistíco, No. 47, San Salvador, 1960, pp. 150-152.

From Table XXIX it is evident that within eastern El Salvador the departamentos of Morazán and La Unión have the highest percentage of rural people, but a lower total population than the departamentos of San Miguel and Usulután. This is explained by the fact that in the former little arable land is available which is suitable for intensive mechanized agriculture, and that most of the people are subsistance farmers scattered throughout the area. In the latter, and particularly

[2] El Salvador, Ministerio de Economía, Boletín Estadistíco, No. 47, San Salvador, 1960, pp. 150-152.

in Usulután, large tracts of farm land are intensively cultivated and are encompassed by an area of intensive coffee cultivation, which explains the higher population needed to work in the production of coffee and intensive cotton and food crop farming, and their more centralized concentration into caseríos, villages, and towns.

The local names ciudad, villa, and pueblo (town, country town, and village), are administrative designations and bear no relation to the function and size of the settlements. The four departamentos (see Table XXX) are divided into districts and eighty-six municipios, or administrative units, each of which has a settlement as administrative center which forms the nucleus. Thus there are eighty-six municipios and eighty-six settlements, all of which are classed as urban, despite the fact that some have fewer than five hundred inhabitants, all of whom are engaged in the pursuit of agriculture. For example, Arambala, a pueblo, and the administrative center of the municipio of Arambala, has a population of 157, all of whom are farmers, including the alcalde, and is classed in the official statistics as an urban settlement.

TABLE XXX--ADMINISTRATIVE AREAS, TOWNS, VILLAGES OF EASTERN EL SALVADOR

DEPARTMENTS	DISTRICTS	MUNICIPALITIES	TOWNS	COUNTRY TOWNS	VILLAGES
Usulután	4	23	8	4	11
San Miguel	3	20	4	9	7
Morazán	3	25	4	8	13
La Unión	2	18	4	7	7
TOTAL	12	86	20	28	38

Source: El Salvador, Ministerio de Economía, Diccionário Geografico de la Republica de El Salvador, San Salvador, 1959.

Theoretically the number of inhabitants of a settlement should be an indication of its importance as a service center. However, there

seems to be no close relationship between size and function. To show the degree of centrality the central places of eastern El Salvador were grouped in Table XXXI on the basis of their services and the areal extent of these services, into five groups, as follows:[3]

TABLE XXXI--GROUPS OF CENTRAL PLACES AND CENTRAL SERVICES IN EASTERN EL SALVADOR

PLACES WITH CENTRAL SERVICES	ENGLISH DESIGNATION	SPANISH DESIGNATION
Group I	Farm	_Finca_ _Hacienda_ _Granja_ (_Rancho_)
Group II	Village	_Pueblo_
Group III	Market Town	_Villa_
Group IV	Town	_Ciudad_
Group V	Regional Center	-

Source: Based on field observation and the _Directorio Telefonico General_, San Salvador, 1960.

The services on the basis of which the central places are grouped in Table XXXI were taken from the telephone directory. However, it should be pointed out that only the most important services, those usually serving a wider area than the people of the town, are listed in the telephone book, and that the small stores, trades people, inns, etc., could not be taken into account since they are not listed. The number of people of the settlements was taken from the 1959 census and data for schools were obtained from the _Diccionário Geografico_ for 1959. Aside from these data, field checks were made throughout the area and of all types of settlements. In the following discussion the smallest central places, farms, are not considered.

[3] See Appendix C.

The central places of Group V are represented by San Miguel, the regional center of eastern El Salvador. Not only does San Miguel differ from the central places of Group IV by a larger number of the same services but there are a number of services that are represented only in San Miguel such as high schools, magistrates, transportation companies, repair shops, and sales agencies for agricultural machines, trucks, and cars. Almost all large firms with headquarters in the capital, San Salvador, have a representative in San Miguel. In addition there are a number of trades people such as chemists, jewelers, tanners, carpenters, a veterinarian, etc.. San Miguel further has a radio station, a newspaper, a number of book stores, a library, and association headquarters for the coffee, cotton, and milk co-operatives. Within the city are also a number of textile and brick factories.

The regional center, San Miguel, owes its importance to its central location within eastern El Salvador along the Pan American Highway connecting with the port of La Union, the largest and most important of El Salvador's three ports, and with the capital, San Salvador, and its population.

A closer examination of the available services reveals that beyond doubt the departmental capitals, Usulután, La Unión, and San Francisco Gotera, which make up the central places of Group IV, are by far the most important of eastern El Salvador's towns, in the services they render to their prospective hinterlands. The following major services are represented.

1. Departmental Administration: (Governor's Office, Courts, National Police, Health, Public Works, and Revenue Departments)
2. Secondary Schools
3. Church
4. Doctor (1-3)
5. Dentist (1-2)
6. Hospital (1-2)
7. Bank (1-3)
8. Lawyer (1-4)
9. Hotel (1-2)
10. Business Offices
11. Garage (1-3)
12. Pharmacy (1-5)
13. Hardware Store (1)
14. Sports and Entertainment Facilities

In addition there are usually numerous dry-goods stores, grocery stores, a score of taxis, and a beauty parlor. These are fully-fledged towns with few people working in agriculture other than the land owners who prefer to live in town rather than on their <u>fincas</u> and <u>haciendas</u>.

The towns, Group IV, are important seats of major administrative functions. With the exception of San Francisco Gotera the population of each exceeds ten thousand, reflecting the importance of the hinterland. San Francisco Gotera serves a comparatively sparsely settled area oriented mainly towards subsistance farming. Situated along the main arteries of transportation the towns are easily accessible by good all-weather paved highways, and with the exception of Gotera, served by the railroad.

The market towns which make up Group III of the central places, are generally situated along the major all-weather roads and serve the surrounding agricultural districts. Most of the people of these towns

are either directly or indirectly, part-time or full-time farmers. The most common services are:

1. Alcaldia: (Local Administration, Police Station, Jail)
2. Elementary School (3-8)
3. Communication: (Telephone, Post Office)
4. Market Place (1)
5. Slaughter House (1)
6. Movie Theater (1)

Aside from the above there are the usual general stores and inns, the occasional gas station, and business office. The larger market towns, situated in the coffee region, have additional services such as a doctor, a small hospital, and a branch of one of the larger city banks. They are somewhat larger than the rest of the market towns due to the coffee beneficios which employ a large number of people. The number of inhabitants varies from 2,249 to 6,262 but most of them have a population of little over four thousand.[4]

The towns of Group III are administrative centers of minor importance, serving the municipio in which they are located. In this respect they do not differ from the centers of Group II, the villages. However, they are gathering places for weekly markets and centers of trade and thus play an important part in the economy of the region. The close association of the countryside with the local market and with the administrative centers is reflected in the names of the centers and those of municipios and departamentos. However, in the market towns as well as in the villages, most people are engaged in extractive

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[4] See Appendix C.

industries, few in the service industries, and only occasionally in manufacture (see Figure 68).

Central places of Group II are listed in the official census as urban centers but are in reality, administrative centers of the municipios, and no more than villages. As a rule all of the people are farmers and make their living as such. The following services are regularly represented.

1. Alcaldia: (Local Administration, Police Station)
2. Church
3. Elementary School (1-3)
4. Telephone (with one or two exceptions)

In addition there may be a small general store, a slaughter house, or an inn. Most of the villages are located on dry-weather roads and are only accessible during the dry season, except by jeep or on foot.

Centers of Group II are to a large degree old Indian villages, and their only service is that of administering justice for the surrounding district (see Figures 69 and 70). Other services, if present, are as a rule only for the people of the village, and seldom amount to anything important.

Of interest is the use of commissaries on most of the large land holdings or haciendas in the coastal lowlands and the interior plains. The hacienda is often a compact settlement or a number of settlements, caserios, where all the workers of the estate live near one another. In this respect the hacienda is similar to a township. Most of the haciendas have a comisario where the workers may buy the most important items they need such as sugar, salt, tobacco, clothing, and other food materials if not provided by the owner or grown by the worker himself.

Fig. 68.--Main street in Ciudad Barrios, the main market town in the north-west of eastern El Salvador.

Fig. 69.--Central plaza of Intipuca, an Indian village in existance prior to the coming of the Spaniards. The house with the flag pole in front, is the "city hall". Note the ever-present <u>amates</u>, the common shade trees of Central America. At right a woman is preparing the family meal in an open-air fire place. During the rainy season the plaza becomes a field of mud.

This may account for the absence of service centers in the intensively used plains and lowlands.

Generally all service centers of Groups IV and III are fairly evenly spaced (see Map XV), approximately 25 to 35 kms. apart with the exception of those centers located in the San Miguel-Tecapa Mountains, and the southern piedmont plains, reflecting the sparser distribution of the rural population which they serve. Thus the distributional pattern of the service centers can be readily understood on the basis of the previously described elements of the formal and functional structure of eastern El Salvador.

Transportation

Of all Central American republics, El Salvador has one of the best developed systems of land transportation and one of the densest networks of roads with a comparatively heavy volume of traffic.[1] In eastern El Salvador roads and railroads are the principle means of transportation.

Of the 8,200 kms. of roads traversing the Republic approximately 2,540 kms. are located in eastern El Salvador. Of these only 360 kms. or 14 per cent, are paved all-weather two-lane highways. Approximately 300 kms. are dry-weather dirt roads. The Pan American Highway (see Figure 71) connecting San Miguel, the regional center, with the capital San Salvador and the port of La Unión, and the coastal highway connecting the coastal lowlands and the town of Usulután with the ports of La Libertad, Acajutla, and La Unión, are the two principle arteries

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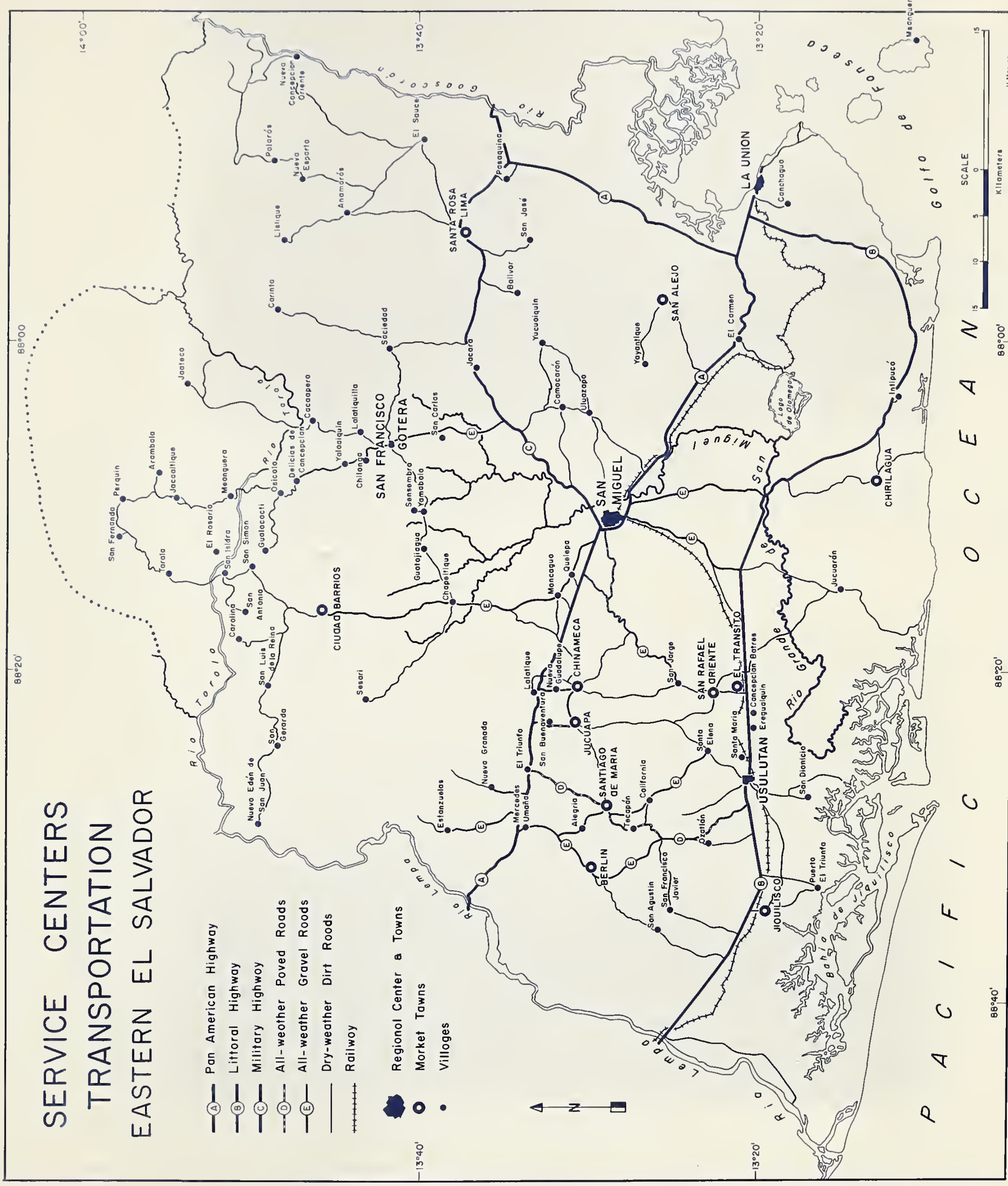
[1] El Salvador, Ministerio de Economía, Atlas Censal, San Salvador, 1952, p. 75.


SERVICE CENTERS
TRANSPORTATION
EASTERN EL SALVADOR
Pan American Highway
Littoral Highway
Military Highway
All-weather Paved Roads
All-weather Gravel Roads
Dry-weather Dirt Roads
Railway
Regional Center a Towns
Market Towns
Villages
N
SAN MIGUEL
USULUTAN
LA UNION
SAN FRANCISCO GOTERA
SANTA ROSA LIMA
CIUDAD BARRIOS
CHINAMECA
JUCUAPA
SANTIAGO DE MARIA
BERLIN
JIQUILISCO
EL TRANSITO
SAN RAFAEL ORIENTE
CHIRILAGUA
SAN ALEJO
PACIFIC OCEAN
Golfo de Fonseca
Rio Lempa
Rio Grande de San Miguel
Rio Torola
Rio Goascoran
Bahia de Jiquilisco
Lago de Olomega
SCALE
Kilometers
13°40'
13°20'
14°00'
88°00'
88°20'
88°40'

MAP XV

Fig. 70.--The church of Intipucá, facing onto the main plaza.

Fig. 71.--The Pan American Highway between San Miguel and La Unión, passing through the morrales east of San Miguel.

traversing eastern El Salvador from east to west. At San Miguel the Pan American Highway branches, one arm leading in a south-easterly direction to La Unión. The other, the Military Highway, branches to the north-east and passes through Santa Rosa de Lima to Puente Goascorán at the border of Honduras. A twenty-eight-kilometer connector route runs north from Sirama and joins the Ruta Militar (Military Highway), just west of Puente Goascorán.

The feeder roads of these two main arteries are generally poor dry-weather dirt roads with the exception of a few all-weather gravel and one-lane paved roads which lead into the coffee regions of the San Miguel-Tecapa Mountains and serve the market towns of Santiago de Maria, Jucuápa, Chinameca, and Berlín. These are the most intensively used roads of eastern El Salvador and many of them have been paved by the owners of the adjoining coffee *fincas* inasmuch as the Government has failed to keep them in repair. Aside from these there are only two all-weather roads branching off to the north from the Pan American Highway; one of them connects the Pan American Highway with San Francisco Gotera and Osicala, and the other San Miguel with Ciudad Barrios. The other all-weather gravel road connects San Miguel with the coastal highway (see Figure 42).

Numerous dry-weather dirt roads extend to all settlements of Group II classed as villages, but they are of poor quality. Frequented mainly by farmers and their ox carts, these roads are used heavily during the dry season. Through time the wheels of the ox carts have cut deeply into the fine volcanic material. With further erosion by wind and water the roadways now occupy miniature canyons, some incised as deeply as thirty feet (see Figures 72 to 74). Few of these dirt

Fig. 72.--The roads on the slopes of the volcanoes and throughout the Interior Valley erode easily and quickly in the soft volcanic materials, forming in places, miniature canyons. Some of them exceed depths of thirty feet.

Fig. 73.--A dry-weather "road" north of San Miguel which was not even passable in dry weather, at least not by automobile.

Fig. 74.--One of the most difficult roads travelled was the dry-weather road from San Agustín across the Volcan Taburete to Berlin.

roads are passable during the rainy season, and then only with greatest difficulty, while during the dry season they can be recognized from afar by an ever-present cloud of heavy red clay dust.

Aside from these roads there are countless trails leading to the caseríos, cantónes, and the ranchos of the small farmers. Much of the marketable product of the farmers reaches the small market centers by these trails or by ox carts. From the market towns which are located on all-weather roads these products leave by bus or truck to the larger centers where they are processed and packed for shipment to either La Unión or Acajutla and La Liertad.

Until very recently the development of transportation routes was closely related to the demands of the export market which means that only those areas producing export commodities were well served with all-weather roads. The remainder of the country was largely without roads. This pattern is still evident throughout large parts of eastern El Salvador, particularly in the northern mountains, in the Jucuarán, and in the La Unión lowlands, where, despite a tremendous increase in the production of cotton, the number and quality of feeder roads is still inadequate. A special problem is posed by the paucity of bridges across some of the major streams. Although some dry-weather roads could be used even in the rainy season, it is the lack of bridges that limits their use to the dry season only, when stream flow has either ceased entirely or has been reduced to a mere trickle.

Judging from the number of buses and other media of transportation it seems reasonable to assume that the road network of eastern El Salvador rather than the railroad, provides the principal means of movement of goods and people. Just as the roads serve to transport local goods,

so the railroad handles the bulk of inter-regional trade and virtually monopolizes the transport of import and export goods from the harbors of La Unión and Acajutla. Of the two railroads serving the country, only the I.R.C.A. (International Railroad of Central America), a single-track narrow gauge railway, serves eastern El Salvador and connects the port of La Unión with the coffee and cotton regions of Usulután and San Miguel. Almost all the cotton and coffee of eastern El Salvador leaves the country through the port of La Unión, to which it is carried by railroad (see Figure 75).

Fig. 75.--Almost all the cotton and coffee of eastern El Salvador leaves the country through the port of La Unión, to which it is carried by railroad.

CHAPTER VI

AGRICULTURAL PROBLEMS AND CONCLUSIONS

El Salvador is an agricultural country deficient in the production of the basic food crops needed to feed adequately a population which, at its present rate of increase, will double before the turn of the century. A dual problem is thus apparent -- a deficit in food production and a rapidly growing population.

The shortage of food crops results from a number of factors. First, non-food crops, particularly cotton, have taken much available land away from the production of cereals such as corn, rice, and *maicillo*, thereby creating a shortage in the production of basic foods and forcing the Government to import these to cover the deficiency in supply. This problem has been in the past, much aggravated by a favorable price situation for cotton. However, it appears that the present unstable price situation will, if it continues, not only retard and eventually halt the increase in acreage for cotton production, but may reduce the present acreage under cultivation.

Secondly, agricultural practices employed in the production of the basic food crops -- corn, rice, beans, and *maicillo* -- particularly among the small producers, are extremely primitive. In most cases these crops are cultivated along steep slopes with the aid of the planting stick and without any prior preparation of the soil. Where the physiography permits the use of plows, a primitive wooden plow is employed

similar to that used by the ancient Egyptian farmer. Drawn by one or two oxen, these plows barely scratch the surface of the soil and do not exceed a depth of three to four inches. Very few small farmers use agricultural machines which only the wealthy land owners can afford. The same is true regarding the use of fertilizers. The small farmer can no more afford to buy a sack of fertilizer than a steel plow or cultivator.

Thirdly, rising prices of land and rising rents caused by the system of land tenure, a high density of rural population, lack of employment opportunities outside of agriculture, and a limited amount of land have been limiting factors in the development of new land. At present production is heavily concentrated in the central uplands (D) where possibilities for any future expansion are very limited. Also within this area live most of the people. This leaves two areas for any new developments -- the northern mountains (E) and the Jiquilisco, and Jucuarán-Conchágua coastal regions (A and C) -- both of which are comparatively inaccessible, particularly during the rainy season.

Of the two possible alternatives for expansion the northern mountains, because of heavy rainfall and steep slopes, are more suited for forest development than farming. The same is true of large parts of the Jucuarán Mountains (C_1). This leaves the Jiquilisco coastal region (A_1) which offers great possibilities for immediate agricultural development. Physiographically the coastal region with its fertile alluvial soils lends itself well to intensive mechanized farming. The opening of this region by a network of all-weather feeder roads from the coastal highway, is far easier compared to the Northern Mountains region. Also of great importance is the fact that the coastal region is more

easily accessible to the main population centers and the ports of La Unión, La Libertad, and Acajutla.

The high cost of land and initial investment needed to clear and prepare the land for cultivation has discouraged small farmers from obtaining land in the coastal region. As a result most of the Jiquilisco coastal region (A_1) is in the hands of a few wealthy land owners and has been given over to cotton production which promises immediate high returns, or to extensive livestock production, due to lack of adequate all-weather feeder roads.

Fourthly, the lack of an adequate all-weather road system throughout the area and particularly in the coastal area (A_2) south of the littoral highway has prevented intensive agricultural development. Although it has been stated previously that in comparison to Central America as a whole the highway system is well developed, it is deficient in all-weather feeder roads connecting agriculturally promising areas to the main highways. As a result large areas have remained marginal in production due to difficult and expensive transportation. The poor road conditions are, in general, responsible and contribute to the high cost of road transport.

Fifthly, the need for soil and moisture conservation is felt greatly throughout the country, particularly if one considers the limited area of agricultural land and the rapid rate of population increase. Accelerated erosion and lack of any organized soil conservation is apparent throughout eastern El Salvador, particularly in the hill lands (D_4) and mountain regions (C_1, E) where landslides in the <u>milpas</u> are common occurences throughout the rainy season. Deforestation of large areas has increased runoff and the debris washed from the slopes clogs

the streams during the rainy season making the water useless for human consumption. Floods in the lower plains and valleys are frequent, spreading sterile sand over the fertile alluvial soils. During the dry season water shortages are acute in many parts of eastern El Salvador, particularly in the eastern hill lands (D_4) and the Jucuarán-Conchágua coastal region (C).

To alleviate the serious problems presented by deforestation and accompanying erosion the Government has initiated reforestation programs in the northern mountains but significant results are not expected until the turn of the century.

In conclusion it may be stated that the population density is high and is increasing rapidly. This means that there must be a substantial increase in the output of basic food crops to raise not only the present inadequate food supply but to keep pace with the growing population as well.

In recent years the Government has encouraged diversification of agricultural production, and increased industrialization in answer to the chronic un- and under-employment problem of the country. Of all agricultural products cotton has made one of the most valuable contributions in the diversification of the agricultural industry and in the development of additional industries for the country. To eliminate the resulting shortages of basic food crops attempts have been made in recent years to make the present acreage alotted to corn more productive by introducing varieties of hybrid corn. If hybrid corn should succeed in replacing the native corn a considerable gap in the present food shortage will be closed and the corn production could be doubled without further increase in acreage.[1]

Provided with an adequate system of all-weather feeder roads, the coastal plain could considerably increase its agricultural production. Cotton production could be extended south of the coastal highway, provided of course that cotton prices continue to make this a profitable operation. In recent years El Salvador has been able to offset a drop in cotton prices through increased production. However, it remains to be seen how long this can be continued. Lands situated closet to the coast could be more intensively used for the production of hybrid corn and rice. Similarly the proposed large-scale drainage projects in the coastal plains of the lower Lempa will be profitable and lead to increased production only if an adequate network of roads is built within the area at the same time.

Large parts of the area north of the littoral highway in regions (A_2) and (D_6) are important producers of corn, rice, and cotton. The Government is at present investigating irrigation possibilities in these areas which, when put into operation, could double the yearly production. The new milk plant outside San Miguel has done much to stimulate milk production and increase consumption.

There is no doubt that regions (A) and (C_5) have the highest potential for increased agricultural production in food crops as well as livestock, if provided with an adequate system of all-weather roads. Region (B) is the most densely populated of eastern El Salvador and includes the second largest coffee producing area of the country. The piedmonts (B_2) are becoming increasingly important as producers of rice,

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[1] There appears to be a strong resentment of hybrid corn among the farmers, as it is harder than the native corn and consequently more difficult to grind. Also, the Salvadoran farmer is no different from any other farmer and is reluctant to experiment with new crops.

hybrid corn, and cotton. The remaining regions have limited possibilities for further development with perhaps the exception of the region (C_1). Small areas in the valleys, especially along the rivers, have lands that could be developed into marginal areas of crop production and some of the higher slopes could probably be used profitably for fruit production,[2] possibly citrus and aceituno (Simaruba glanca). Any increases in production in the remaining regions will have to come from new crop types and particularly improved agricultural methods and the use of fertilizer.

Provided that the Government continues its agricultural development program with the aid of the United Nations, eastern El Salvador should continue to diversify and develop its agricultural resources and further increase its production of cotton, corn, rice, beans, and maicillo, and truly become the bread basket of the nation.

[2] The aceituno is an indigenous tree of Central America, the seed of which is used in the production of vegetable oil. The trees reach heights in excess of twenty meters, prefer fertile soils, but will do as well in poor soils.

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APPENDIXES

APPENDIX A

At present there exists no reliable figure for the exact size of the Republic of El Salvador and at least five different figures are in use. The "official" size of the country is given at 34,126 sq. kms.; this was estimated by Dr. Santiago I. Barberena in 1892, and adopted twice by government decree, first in 1901, and the second time in 1927.[1] Although the Government is aware that this estimate is unrealistic this estimate is still found in official Government publications.[2]

In addition to the above figure, the United States Geodetic survey gives a figure of 21,158 sq. kms., which is close to the 21,160 sq. kms. given by the Geographic Institute of Justus Perthes, Gotha. In addition to these, the Department of Cartography of the Republic has arrived at 20,877 as being the most accurate. The issue is further confused by the Direccion General de Estadistica y Censos (the Government Census Bureau), which uses 20,000 sq. kms. as the basic figure on which all calculations for the 1950 census are based.

Due to the multiplicity of choice I selected the figure of 21,160 sq. kms., given by the Geographic Institute of Justus Perthes, Gotha, as the most accurate. This choice was made purely on the basis of the reputation of the Institute.

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[1] R. Baron Castro, La Poblacion de El Salvador, Madrid, 1942, p.28.

[2] El Salvador, Memoria del Primer Congreso Pecuario Nacional, San Salvador, 1953, p. 156.

APPENDIX B

An accurate areal classification of land resources for El Salvador seems to be lacking. The distribution used in Table XIV was based on information obtained from the 1950 census. However, the Atlas Censal, published by the Direccion General de Estadistica y Censos, an official government department, lists completely different information, as compared to the publication of the Ministerio de Agricultura y Ganaderia, also based on the 1950 census statistics.

The Atlas Censal lists the following distribution:[1]

	HECTARES	% OF TOTAL AREA
TOTAL AREA	1,530,323	100.00
Arable Land	391,059	25.55
Permanent Cultivations (not arable)	153,220	10.01
Unimproved Pastures	529,487	34.60
Improved Pastures	174,881	11.43
Montes y bosques	205,510	13.43
Land not cultivated	76,166	4.98

In comparason, the Ministry of Agriculture and Animal Husbandry, gives the following:[2]

	HECTARES	% OF TOTAL AREA
TOTAL AREA	2,116,000	100.00
Arable Land	297,162	14.00
Permanent Cultivations (not arable)	268,469	12.60
Forest and Marshlands	36,882	1.30
Other Lands (not cultivated but available for cultivation: lakes, estuaries, roads, settlements, etc.)	1,523,487	72.10

[1] El Salvador, Ministerio de Economía, Atlas Censal, San Salvador, 1952, p. 45.

The most obvious discrepancy between the two classifications is manifested in the total area classed by the Atlas Censal as cultivated, which is approximately equal to the amount listed by the Panoráma General de la Producción, Distribución y Consumo de los Principales Renglones Agropecuarios, as being not cultivated but available for cultivation.

[2] El Salvador, Ministerio de Agricultura y Ganaderia, Panoráma General de la Producción, Distribución y Consumo de los Principales Renglones Agropecuarios, San Salvador, 1957, p. 2.

APPENDIX C

GROUPS OF SERVICE CENTERS OF EASTERN EL SALVADOR

GROUP	NAME	SIZE	TOTAL
Group V -	Regional Center		1
	San Miguel	34,049	
Group IV -	Towns		3
	Usulután	12,674	
	La Unión	10,966	
	San Francisco Gotera	3,848	
Group III -	Market Towns		11
	Santiago de Maria	8,133	
	Chinameca	7,012	
	Berlín	6,262	
	Jucuapa	5,431	
	Jiquilisco	4,498	
	Santa Rosa de Lima	4,195	
	San Alejo	4,064	
	Chirilagua	4,002	
	El Transito	3,773	
	San Rafael Oriente	3,511	
	Ciudad Barrios	2,249	
Group IV -	Villages		71
	Santa Elena	4,298	
	Guatajiagua	3,338	
	Ozatlan	3,191	
	San Jorge	2,795	
	Estanzuelas	2,774	
	Lolotique	2,617	
	Nueva Guadalupe	2,300	
	Intipucá	2,194	
	Jocoro	2,117	
	San Agustín	1,960	
	Pasaquína	1,867	
	Mercedes Umaña	1,644	
	Conchágua	1,623	
	San Buenaventura	1,588	
	Batres	1,587	
	Alegria	1,560	
	Yucuayquin	1,484	
	El Triunfo	1,332	
	Chapeltique	1,270	

Tecapan	1,259
Carolina	1,200
Jucuarán	1,176
El Sauce	1,170
Nueva Granada	1,166
Moncagua	1,135
California	1,078
Corinto	1,075
Quelepa	1,073
San Gerardo	1,067
El Carmen	1,061
Cacaopera	1,058
Uluazapa	1,015
Yayantique	996
Ocicala	972
San Francisco Javier	968
Nueva Esparta	959
Delicias de Concepción	935
San Jose	882
Santa Maria	870
Chilanga	830
Sesori	788
Meanguera del Golfo	774
San Simon	764
Lolotiquillo	763
Bolivar	756
Sociedad	756
San Luis de la Reina	752
Anamorós	747
Nuevo Edén de San Juan	703
Ereguayquín	661
Jocoaitique	648
Comacaran	636
Concepcion de Oriente	633
Poloros	624
Sensembra	563
Torola	540
Gualococti	531
San Dionisio	522
Joateca	499
Puerto El Triunfo	456
El Rosario	443
Lislique	436
San Isidro	432
Yoloaiquin	428
San Carlos	393
Meanguera	362
Yamabala	353
San Fernando	282
San Antonio	280
Perquin	238
Arambala	157